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Abstract

Introduction*:** Our study reviews published literature about the determinants of family planning, specifically studies that examined contraceptive use, non-use, and unmet need. We sought to understand the state of knowledge in the field, particularly as it relates to *when, where,* and *by whom* that knowledge is produced. ***Methods*:** Our extensive scoping review identified all articles published between 2000-2016 on the determinants of family planning in FP2020 countries. We use bibliometric tools and techniques to identify authors' institutional and national affiliations, as well as their citation counts to assess how authorship characteristics contribute to knowledge production ***Results*:** Descriptive analysis of our curated database shows that *contraceptive use* was most frequently studied each year. Articles on Asia and Africa were published at a similar rate until 2008 when the number of studies on African countries increased dramatically relative to other FP2020 regions. We also found that most research on family planning was collaborative and focused on a single country of interest. Teams of authors had the highest rates of publication across all family planning outcomes, with teams of men and women representing the largest authorship type based on gender and teams from the Global South representing the largest group based on global location. However, our bibliometric analysis found that characteristics associated with most family planning behavior research were not those associated with citation counts. In particular, research published by authors affiliated with Global South institutions received significantly less citations compared to groups of authors affiliated with institutions in the Global North and Global South. ***Discussion: Citations counts are often seen as a measure of scientific impact and attention paid by the scientific community to specific research results. Our findings indicate preference for certain authorship characteristics over others based on citations, implicating concerns about knowledge diffusion disparities in family planning literature.

Introduction

Technological and methodological advances in recent decades played a critical role in shaping the field of demography and the production of population knowledge. Improved computer technology allowed researchers to process larger and more complex datasets while also giving rise to new data analysis tools. These changes helped decentralize data analysis, which historically limited demographic research to select institutions with the requisite computer programming capabilities. They also pointed to a potential democratization of the field whereby analysis of demographic data could eventually be done anywhere by anyone with minimal support and resources (Crimmins 1993).

Despite this potential for easier and more cost-effective data analysis worldwide, the concentration of demographic training in universities, particularly within population centers, and challenges with accessing restricted data sources simultaneously contributed to a bureaucratization of demographic research, as well as the production and reproduction of new inequalities of knowledge production across national and social contexts (Greenhalgh 1996; Teachman, Paasch, and Carver 1993). Countries like the United States, France, and the United Kingdom increasingly represent 'world social science powers' because of their outsized influence on other countries seen as consumers rather than producers of research (Alatas 2006; Collyer 2014). These European and North American countries operate within a 'global metropole', a socially rather than geographically-constructed classification based on relations between institutions situated in the metropole (Global North) and the periphery (Global South) (Collyer 2014; Connell 2020). Institutions within the Global North produce a high volume of research within a global, hegemonic system "induced with relations of power and characterized by a fundamentally unequal relationship between the intellectual 'core' and its periphery

(Collyer 2014:252–253). Despite the growing awareness of this imbalance, more comparative analyses are needed to understand the underlying mechanisms shaping knowledge production.

Academic institutions in the Global North operate within hyper-competitive systems where publications and citation counts shape individual career trajectories, research funding, and institutional prestige (Akbaritabar and Squazzoni 2021; Edwards and Roy 2017; Nederhof 2006). The centrality of these quantitative metrics, incorporated in policy measures and used to evaluate individual and institutional scientific merit, induces an increase in the number of papers published each year in most fields. Whether this growth advances knowledge is a matter of debate (Chu and Evans 2021). These systems historically disadvantaged women, often through hiring and compensation practices resulting in lower pay and lower-level roles at less prestigious institutions (Heijstra, Bjarnason, and Rafnsdóttir 2015; Lomperis 1990). Despite the growing number of women in science, research on gender publication patterns shows that women produce fewer publications and receive fewer citations than men (Akbaritabar and Squazzoni 2021; Cole and Zuckerman 1984; Maliniak, Powers, and Walter 2013; Xie and Shauman 1998; Young 1995).

Collaborative research projects present an opportunity to increase scientific productivity by bringing researchers from various backgrounds, disciplines, and specializations together (Endersby 1996; Lee and Bozeman 2005). Incentives to collaborate include increased efficiency through the division of labor and improved quality through joint review (Endersby 1996). Projects incorporating multiple authors now represent the norm and may not be surprising given the increasing complexity and cost of scientific research (Lee and Bozeman 2005; Teachman et al. 1993). However, assuming the benefits of collaborations are universal and positively associated with research productivity can mask important differences in the experiences of

researchers based on characteristics like their gender and geographic location. Researchers studying women's collaboration patterns vis-à-vis men found that women tend to form smaller, more homogeneous networks (Grant and Ward 1991; Renzulli, Aldrich, and Moody 2000) and incorporate research methods that are largely qualitative and less specialized (Grant and Ward 1991; Leahey 2006). These approaches challenge hegemonic understandings of scientific knowledge production and meaningful contributions to the field, which negatively impacts women's research productivity. However, these research practices are not inherently unproductive and instead must be understood as operating within institutions that privilege and reward certain research agendas over others.

As researchers operating within a global system, the study of patterns in knowledge production, dissemination, and exchange has become increasingly important. Bibliometric methods allow us to quantitatively assess such patterns by analyzing scientific content and citation counts as a measure of research performance. Citation analysis, which is more commonly applied to evaluate scientific impact, can also reveal important relationships between groups published within the scientific community (Ellegaard and Wallin 2015). Findings from these analyses may be used by researchers to identify new trends in research as well as new opportunities for collaboration. At the same time, these methods have their limitations as proxy measurements of scientific impact and influence (Wallin 2005) and may mask the various factors that influence citation behavior. This includes the growing number of citations from year to year, which may decrease the probability of being cited; the influence of citation practices within different fields and associated journals; the types of publications (e.g., research notes, review articles); and the language an article is written in, which may affect readership (Bornmann and Daniel 2008). These patterns contribute to a citation inequality that appears to be increasing over

time (Nielsen and Andersen 2021) where well-cited papers continue to disproportionately accumulate more citations compared to newer, more disruptive publications (Chu and Evans 2021).

Citation behavior is often theorized as either normative (Merton 1973) or socially-constructed (Gilbert 1977). According to normative theory, researchers use citations to acknowledge the contributions of literature that is relevant to their work, while the social constructive approach argues that citation behavior is a more psychological process motivated by social pressures like the desire to cite literature that supports one's argument (Bornmann and Daniel 2008) and in some cases challenging previous literature in the process (Lamers et al. 2021). For example, unequal power relations between institutions in the metropole and periphery can reinforce processes of "academic dependence" (Alatas 2003) by limiting the role of researchers in the Global South to data collection while encouraging those in the Global North to drive theoretical and methodological innovation (Collyer 2018). This delineation of roles shapes our definition of publishable knowledge thereby positioning individuals in the metropole as producers of knowledge and those in the periphery as consumers of knowledge. Citation analysis provides evidence of these patterns as researchers in the Global North tend to be more inwardly focused, citing their own research as well as the work of others in the metropole while researchers in the Global South largely cite those in the metropole, resulting in unequal citation counts based on global location (Collyer 2014, 2018; Danell 2013). Citation behavior may vary from author to author, but the significance ascribed to publication and citation counts in hiring, promotion, and research funding suggests that these decisions, in the aggregate, can have a powerful influence on knowledge production and dissemination (Akbaritabar and Squazzoni 2021; Cole and Zuckerman 1984; Maliniak et al. 2013; Xie and Shauman 1998; Young 1995).

Widespread dissemination of scientific knowledge is a crucial contributor to translating knowledge into action, but the distribution of knowledge in many areas of human concern is understood to be uneven, hindering effective progress (Adriansen 2020). Governments and multilateral organizations in the Global North, in addition to academic institutions, have certainly increased their investment in the production of scientific knowledge on emerging issues in the Global South. However, in some disciplines, this knowledge is still mostly produced by Global North scholars, or with the involvement of Global North scholars as the main contributors (Habel et al. 2014). Similarly, unequal patterns in the division of scientific labor have emerged in other fields, in which Global South scholars provide the fieldwork, data points, and case selections while Global North scholars perform the analyses, computing activities, and other allocation activities for which they receive more credit (Boshoff 2009; Habel et al. 2014). It remains to be seen whether knowledge production in the family planning field, which is greatly engaged with answering questions about family planning attitudes, motivations, and behaviors in the Global South, follows similar patterns.

Initiatives like Family Planning 2020 (FP2020), which emerged from the London Summit on Family Planning in 2012 (Family Planning 2030 n.d.), place a strong emphasis on monitoring and evaluation of core family planning outcomes in the 69 countries of interest in Asia, Africa, Latin America, and Oceania. Our team conducted a scoping review of the literature published between 2000-2016 on family planning behaviors in FP2020 countries to understand the state of knowledge in the field. We used descriptive statistics to measure the distribution of articles in our database by year (*when*) and geographic location (*where*). Bibliometric analysis allowed us to investigate how the number of countries studied; the number of authors; and authors' gender,

location of affiliated institutions, and collaborations shape knowledge production on family planning outcomes (*by whom*).

Our study advances research on knowledge production in two key ways. First, it provides an expert analysis of the literature by carefully selecting, hand-coding, and categorizing published research in terms of study characteristics and geographic location along three different dimensions of family planning behavior, i.e., contraceptive use, non-use, and unmet need. Second, it offers an empirical analysis of the content and metadata of the literature in our curated database using bibliometric tools and techniques, allowing us to present geographic and temporal trends in the production of scientific knowledge on the determinants of family planning behavior.

Our comprehensive examination begins with a descriptive analysis of where, when, and by whom research is being done based on the distribution of articles in our database. Next, we apply a new set of methodological tools to assess how knowledge is produced and reproduced in this field of inquiry through bibliometric analysis of publication and citation counts. In our review of the literature, we identify patterns in the concentration and diffusion of research that shed light on our collaborative practice as social scientists and how they inform knowledge production on the determinants of family planning behavior.

Research Questions

1. When, where, and by whom is knowledge about the determinants of family planning produced?
2. How are the characteristics of knowledge production associated with higher impact and greater attention from the scientific community?

Data and Research Methods

A scoping review was conducted to identify study design strategies and methodological approaches taken in the study of the determinants of contraceptive use, non-use, and unmet need. Scoping reviews are designed to classify a body of literature with regard to time, location, source, and origin; clarify working definitions and conceptual boundaries in a given topic or field, and identify gaps in the literature (Anderson et al. 2008; Peters et al. 2015). This differs from a systematic literature review, which is a "comprehensive search for relevant studies on a specific topic, [where] those identified are then appraised and synthesized according to a predetermined explicit method" (Klassen, Jadad, and Moher 1998:701). Rather than appraising the quality and rigor of the identified studies, this review characterizes the size and scope of the literature to understand the nature and extent of research evidence on the determinants of family planning (Grant and Booth 2009). Finally, a scoping review is well suited to synthesize a body of literature that "exhibits a large, complex, or heterogeneous nature not amenable to a more precise systematic review" (Peters et al. 2015), as is the case with this study.

Our search included articles a) published between January 1, 2000, and December 31, 2016, and b) focused on FP2020 countries. These inclusion criteria were developed to incorporate research on sites of significant programmatic and policy interest after the Millennium Development Goals (MDGs) were signed in September 2000. Our search also included FP2020 regional classifications to ensure multi-national and comparative studies of relevant countries were included in cases where titles and abstracts did not specify country names.

Relevant studies were identified using three electronic research databases: PubMed, Embase, and POPLINE. These databases were identified based on their application in comparable studies on family planning and their coverage of public health and the social sciences based on consultation from library science experts. The PRISMA flow diagram in

Figure 1 summarizes the methodological process for our scoping review and subsequent bibliometric analysis.

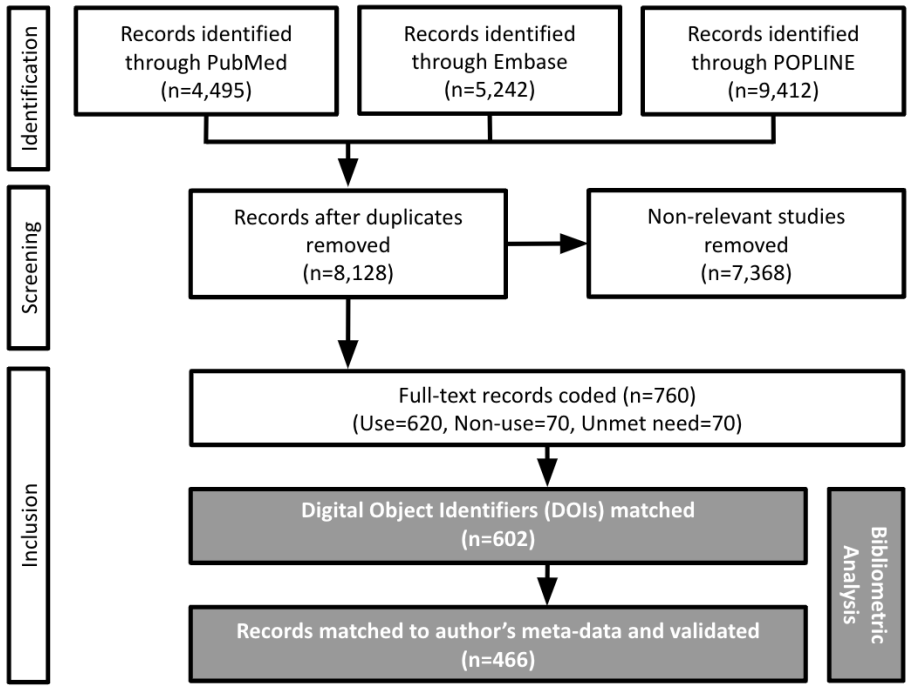

Figure 1. PRISMA flow chart diagram detailing article identification, screening, and review

Articles in the identification stage were retained if:

1. The title and/or abstract included "contraception" OR "contraceptive use" OR "contraceptive prevalence rate" OR "family planning" OR "unmet need AND family planning"

   AND

2. The title and/or abstract included the name of the regions of interest/country

   AND

3. The date of publication was between January 1, 2000 and December 31, 2016.

During the screening stage, articles were assigned an identification code and duplicate articles were removed. Titles and abstracts were then reviewed by members of the research team to determine relevance. A secondary review of the remaining literature was then conducted using inclusion and exclusion criteria developed through an inductive and iterative process as coders reviewed articles, assessed their relevance with members of the research team, and revised the codebook accordingly. Articles were included if the outcome variable was classified as determinants of use, non-use, or unmet need. Studies that focused on contraceptive use were included only if they focused on women or if women's behavior was distinct from contraceptive use by men or couples in the analysis. Articles were excluded if the outcome variable was unrelated to behavior and if the sample population was based on specific occupations, job categories, or health statuses that would not be representative of the larger population. All articles in the database were hand-coded and reviewed by at least two researchers to ensure intercoder reliability. Differences in coding were brought back to the larger group to reconcile as a team. The final database included 760 articles, which are further defined in **Figure 1**.

To complement our scoping review data, we used Digital Object Identifiers (DOIs) of the selected publications (N = 602) and queried a 2020 snapshot of Elsevier's Scopus provided to us by the German Competence Centre for Bibliometrics[1] for further meta-data (N matched and validated = 466) on authors, organizations, countries, and impact (as measured by citations). We then controlled matched articles' titles to validated DOIs matches to ensure data quality, as DOIs have been criticized for being prone to error (Akbaritabar and Stahlschmidt 2019). Bibliometric analysis of articles in our database allowed us to study geographic and temporal trends in the production of scientific knowledge on the determinants of family planning behaviors.

[1]This study has received access to the bibliometric data through the project "Kompetenzzentrum Bibliometrie" and the authors acknowledge their funder Bundesministerium für Bildung und Forschung (funding identification number 01PQ17001).

We evaluated the contribution of different variables including author's gender (men and women), country of affiliation (divided to Global North and Global South), single or multiple authorship (teams' effect) and year of publication (recency effect) on explaining the number of citations received by the publications three years after the publication date (as a proxy for the attention that community pays to a specific publication in an equal amount of time as other publications. For instance, citations accrued by a publication in 2011 are counted from 2011 to 2013 and for a publication in 2013, years from 2013 to 2015 are considered. The choice of three years was informed by previous literature considering disciplinary differences to allow enough time for publications to accrue and citations to mature (Wang 2013). We experimented with aggregate count of citations post-publication and results were consistent with our chosen models hence we present the three years citations as more reliable and level playing field for all publications. We developed fixed effect models and included the described variables in combination with the family planning behavior outcome (use, non-use, and unmet need). Our choice of fixed effect models was informed by the decision to allow a varying intercept in count of citations based on the effect of these variables. We further experimented with other types of models such as hierarchical linear models (Faraway 2005; Snijders and Bosker 1999; Zuur et al. 2009) and considered a nested structure controlling for both fixed effects (a varying intercept) and random effects (a varying slope). Upon observing the results, which were rather similar and consistent, we decided to use the most parsimonious models with the lowest BIC and AIC measures.

In one set of models, we included only family planning outcome as the main fixed effect, and different models included our fixed effects of choice and in a full model we considered the

combination of all variables. We used a negative binomial family of models to account for both the "count" nature of citations and the dispersion patterns of the counts (**Figure 2**).

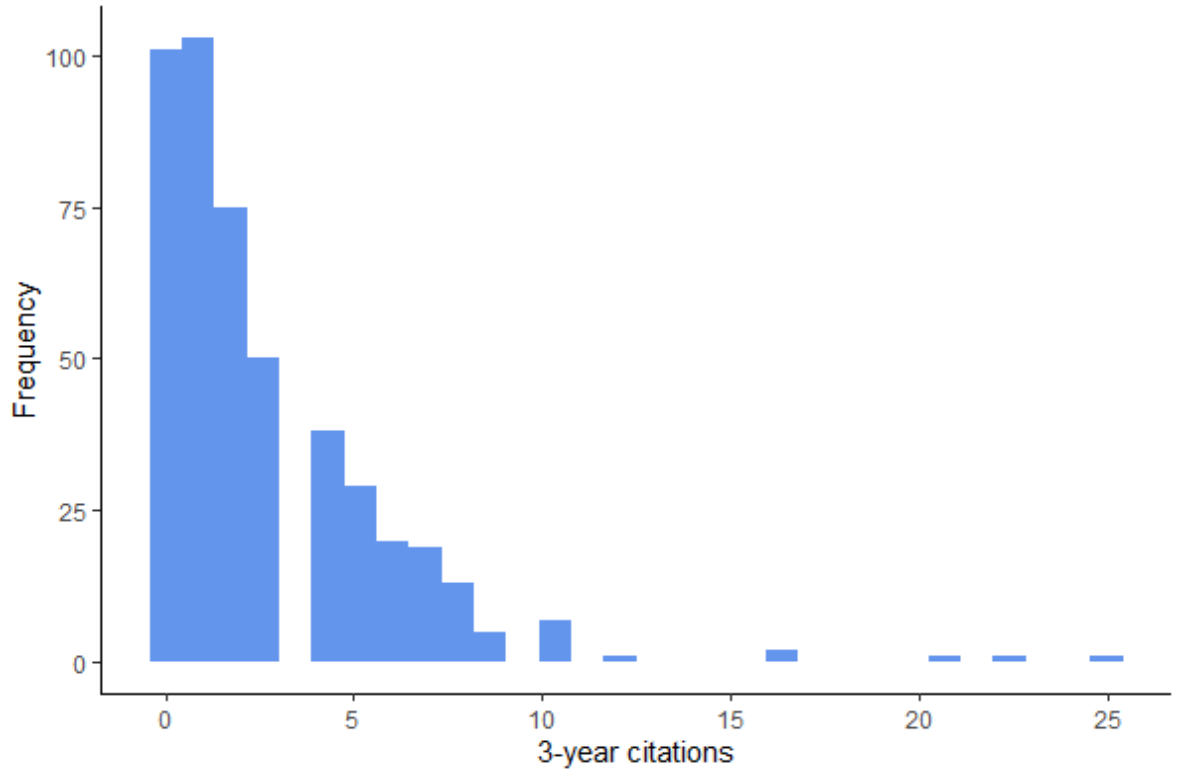

Figure 2. Distribution of Citation Counts

Results

Scoping Review

The FP2020 Initiative classifies 69 countries of interest into eight regions: Eastern and Southern Africa (17), Western Africa (15), Southeast Asia and Oceania (9), South Asia (7), Central Africa (6), Middle East and Northern Africa (6), Eastern and Central Asia (5), and Latin America and the Caribbean (4). **Table 1** provides summary statistics on the frequency and percentage of published articles included in the database based on the FP2020 Initiative classifications.

FP2020 Focus Areas	*Database Articles* **n**	*Database Articles* **%**
Africa	**399**	**57.97**
Eastern and Southern Africa	186	24.47
Western Africa	176	23.16
*Middle East and Northern Africa**	31	4.08
Central Africa	25	3.29
Multiple Regions	15	1.97
Asia	**293**	**38.55**
Eastern and Central Asia	240	31.58
South Asia	44	5.79
Southeast Asia and Oceania	5	0.66
Multiple Regions	3	0.39
*Middle East and Northern Africa**	1	0.13
The Americas	**13**	**1.71**
Latin America and Caribbean	13	1.71
Multiple Continents	**21**	**2.76**
Multiple Regions	21	2.76
Totals	**760**	**100.0%**

** The Middle East and Northern Africa region and Latin America and Caribbean region are listed twice because the countries in these FP2020 areas of interest span across two continents.*

Table 1. Frequency and percentage of studies on FP2020 countries by region and continent

The majority of studies in our database focused on countries in Africa (58%), where articles on the Eastern and Southern Africa region had the highest frequency (24.5%) closely followed by Western Africa (23.2%). 38.6% of articles in our database studied Asian countries with articles on South Asia (31.6%) representing the largest region in Asia and across all FP2020 regions. Less than 2% of the articles included in the database studied Latin America and the Caribbean, which combined published literature from North and South American countries. Multi-country studies cutting across FP2020 regions represented 2.8% of articles in our database.

Our study used descriptive analysis to assess *when* research on family planning behaviors was published. **Figure 3** presents the temporal distribution of articles in the database published between 2000 and 2016. The number of articles published on the determinants of family planning behaviors fluctuated from 2000 to 2007 but began to steadily rise during the second

half of the period between 2008 and 2016. Articles on contraceptive use were most studied each year compared to articles on contraceptive non-use and unmet need.

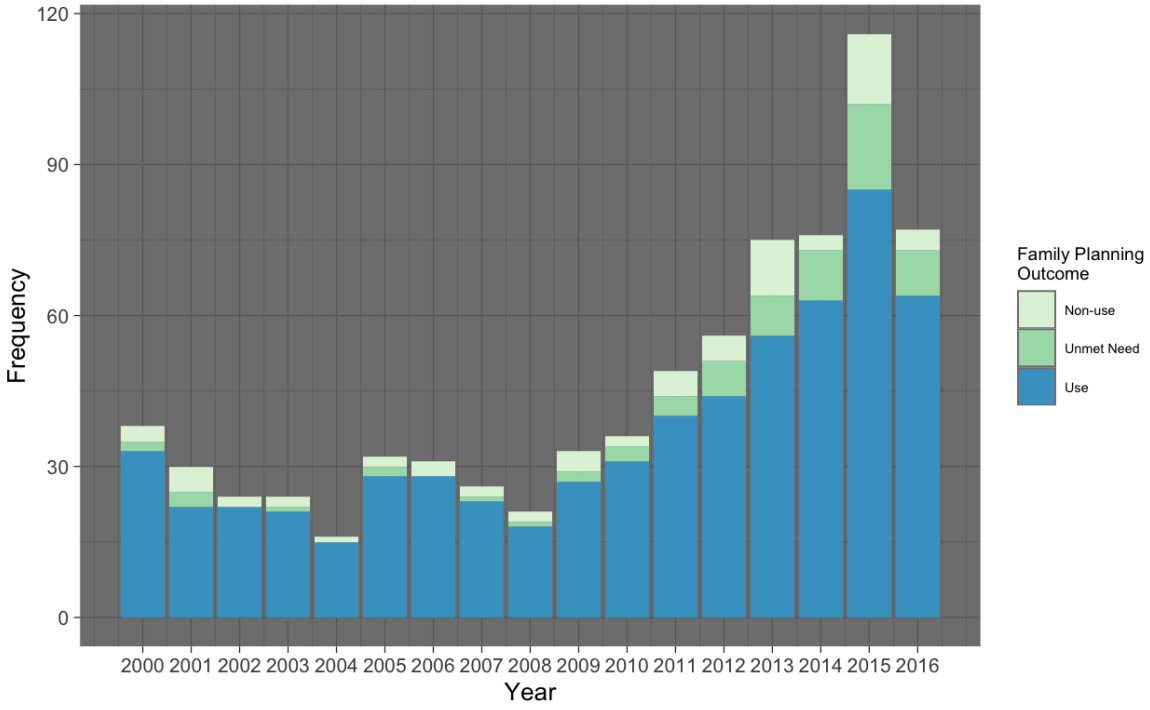

Figure 3. Distribution of studies by year of publication and family planning outcome

Disaggregation by FP2020 regions revealed a similar pattern. **Figure 4** demonstrates that studies on countries within Asia and Africa were published at a similar rate between 2000 and 2007 before the number of articles on African countries (four categories in blue along the bottom of each bar) began to increase dramatically starting in 2008. From that year onward, articles on the determinant of family planning were largely focused on FP2020 regions in Sub-Saharan Africa.

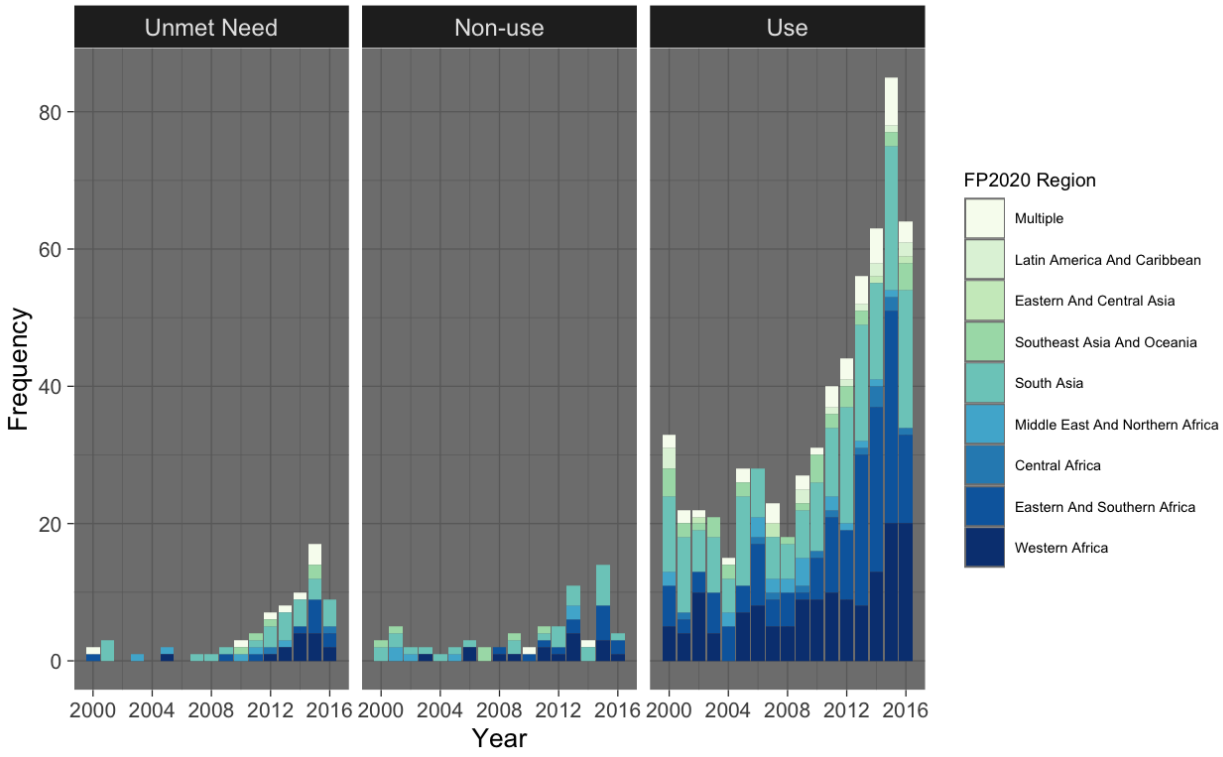

Figure 4. Distribution of studies by year of publication and FP2020 region

A separate study conducted by members of the research team identified and evaluated trends and patterns in research design characteristics across time, geographies and family planning outcomes using the same database of articles (Vignau-Loría et al. n.d.). In that study, Total Fertility Rate (TFR) and modern Contraceptive Prevalence Rate (mCPR) estimates for the year 2000 were used to assess whether knowledge production was associated with key reproductive health indicators. The number of articles in our database was not correlated with the TFR or mCPR in FP2020 countries. In other words, where people were studying was not necessarily where the TFR of mCPR were highest. In the next section, we shift our analysis of geographic and temporal trends from the study sites to the authors represented in our database.

Bibliometric Analysis – Characteristics of Collaboration

Bibliometric analysis was conducted to investigate how authors' gender, institutional affiliation, and collaborations shape knowledge production on family planning behaviors. This analysis was based on the articles linked by DOIs and matched to authors' meta-data (N=466), which differs from the previous descriptive analysis of all articles in the database. Articles were grouped by single-country and multi-country studies to understand how article characteristics may differ with comparative studies. Single country studies (N=414) and multi-country studies (N=52) were further disaggregated by family planning outcomes (i.e. contraceptive use, non-use and unmet need). All co-authors were included in our bibliometric analysis to capture the full composition of research teams in descriptive analysis (Figures 4, 5, 6) and articles were categorized to single author or team authorship in statistical models (Figure 7).

Authorship by gender was categorized into six types: groups of both men and women, groups of men, groups of women, single-authored papers by men, single-authored papers by women, and cases where author gender was unknown. **Figure 5** presents our findings on the distribution of authors in our database by gender. Articles published by teams of men and women accounted for nearly half (48.55%) of all publications in our database. This was followed by groups of men (17.9%) and groups of women (10.6%). Group authorship was most common across the determinants of family planning with the exception of contraceptive non-use, where single-authored articles by men (13.5%) were the second most published.

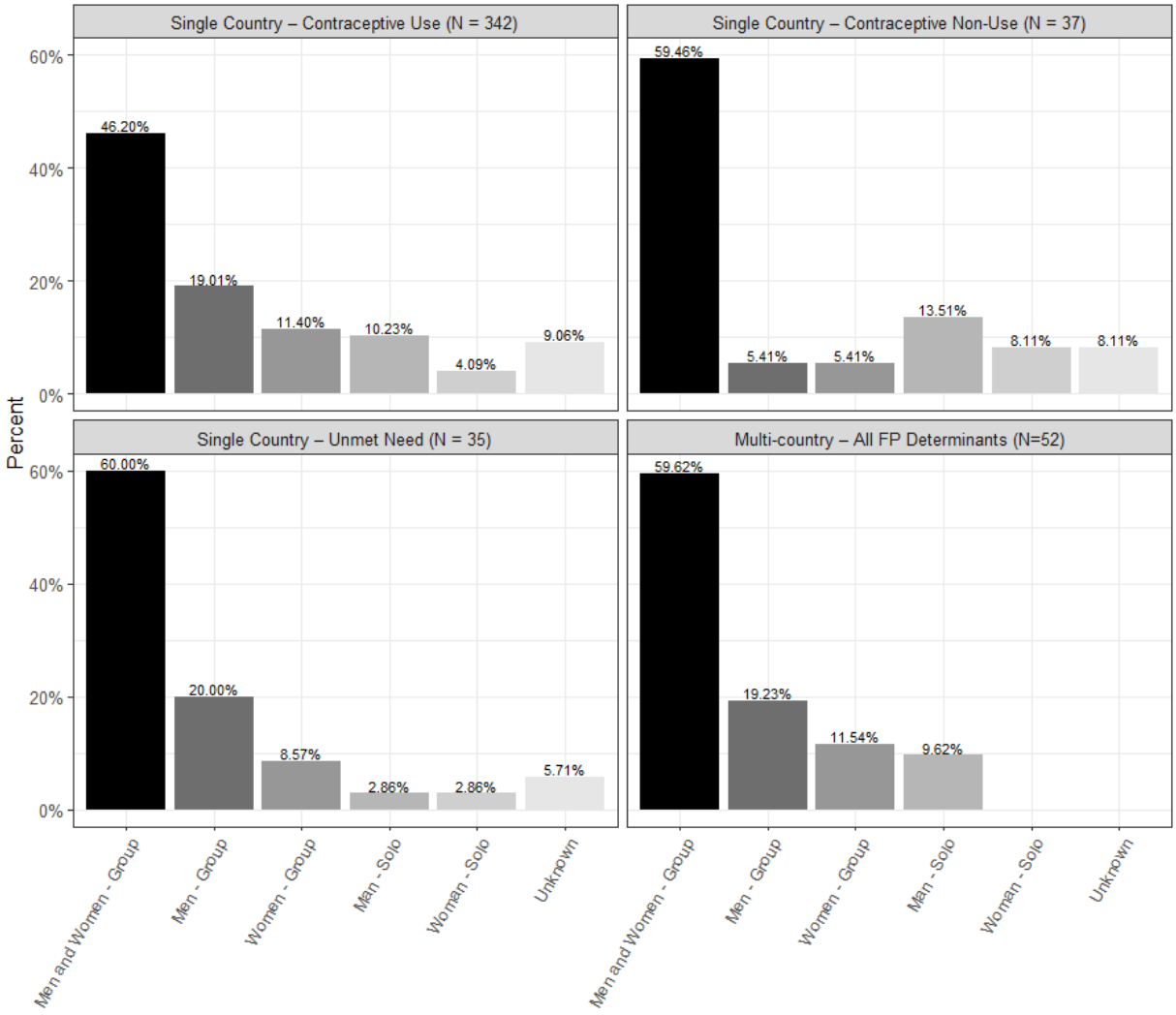

Figure 5. Distribution of authorship by gender

We then studied authorship by geographic location based on the authors' affiliated institutions. Authors were grouped into five categories for analysis: mixed groups from the Global North and Global South, groups from the Global North, groups from the Global South, single-authored from the Global North, and single-authored from the Global South. We base our classification of "Global South" countries on membership within the UN South-South Cooperation (Organization in Special Consultative Status with ECOSOS of the United Nations, 2015). All other countries were classified as part of the "Global North." This categorization

places all 69 FP2020 within the Global South. **Figure 6** presents our findings on the distribution of authors in our database by geographic location.

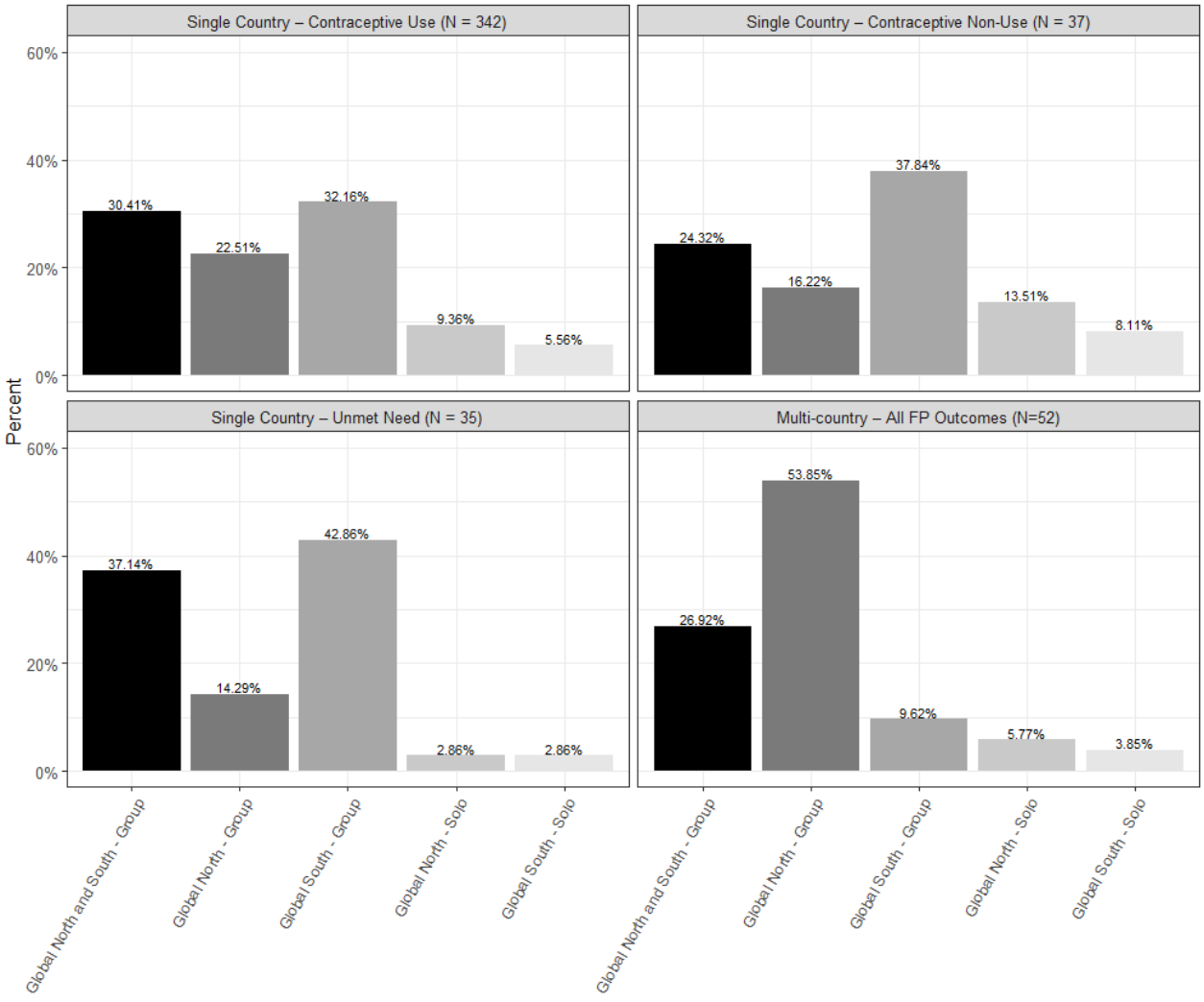

Figure 6. Distribution of authorship by geographic location of affiliated institution

Among single country studies, articles published by teams of authors from the Global South represented the largest percentage of publications (above 32% for family planning outcomes). Groups of Global North and Global South authors represented the second most published group across all family planning outcomes (above 24% for family planning outcomes). Group authorship was again most common, however, our analysis revealed that single authors

from the Global North were published more frequently than single authors from the Global South (except in unmet need that both had 2.86% of publications). On the other hand, analysis of multi-country studies showed that groups of authors from the Global North were published more frequently than authors from the Global South.

Bibliometric Analysis – Citations

Next, we analyzed the distribution of authors based on the geographic location of their affiliated institutions to observe whose research receives more attention from other members of the scientific community. We used citations in the first three years after publication to allow for comparisons between different publications, rather than the aggregated count of citations, which is time-dependent. The location of the author institution is presented by country codes on the x-axis while the number of citations received in those publications in the first three years post-publication is presented on the y-axis. **Figure 7** presents our findings on the countries contributing to the published literature.

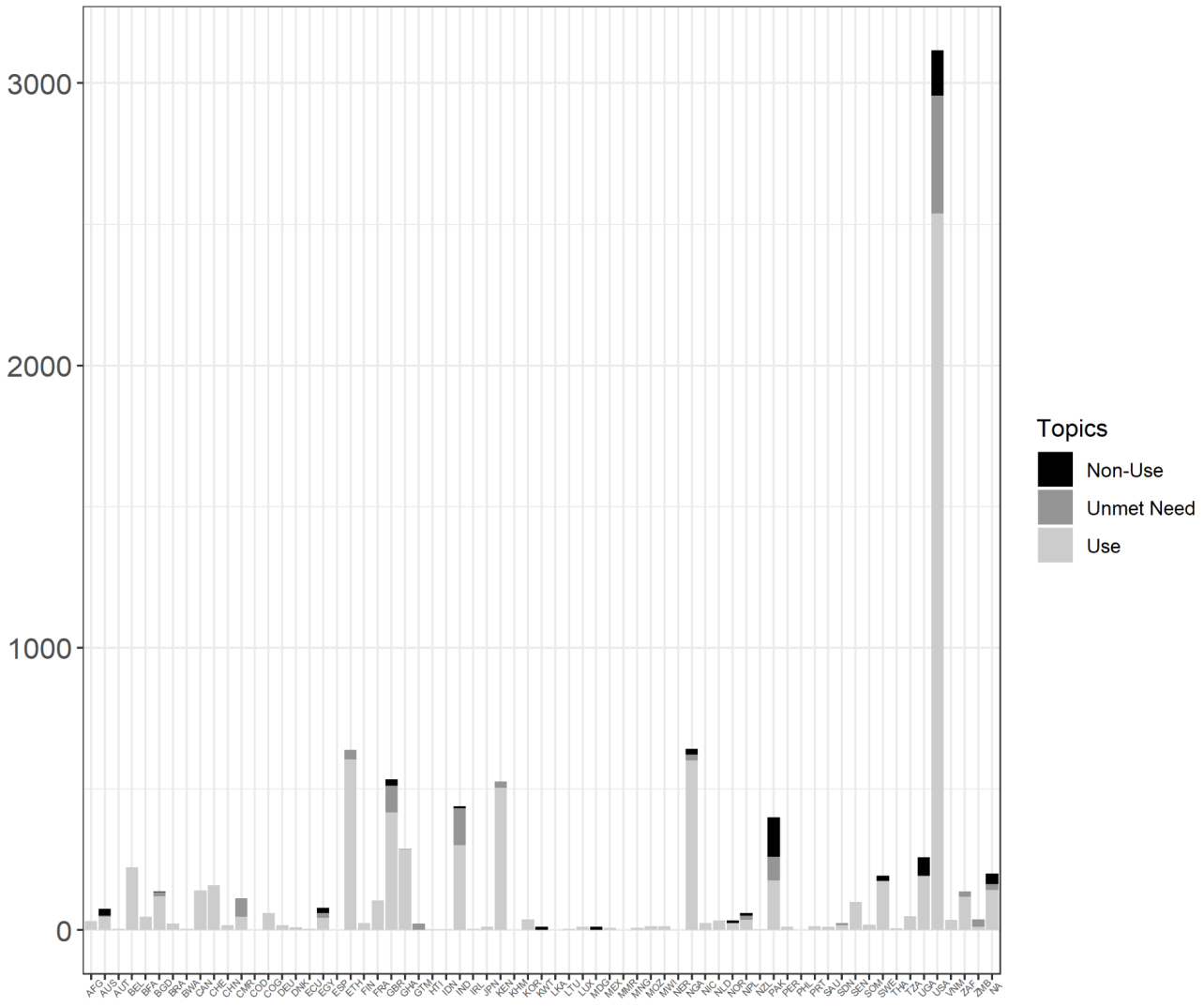

Figure 7. Location of author institution (x-axis) versus number of citations received in the first three years after publication (y-axis) by family planning outcomes

First, we found that studies on contraceptive use (which had the highest share of publications, see Figure 3) were the most cited among family planning outcomes. Second, the geographic distribution showed that authors from the United States (USA) received the highest citation numbers by far. Studies by authors from the FP2020 countries like Nigeria (NGA), Ethiopia (ETH), Kenya (KEN), India (IND), and Pakistan (PAK) as well as the United Kingdom (GBR) also received relatively high citations. Additional analysis revealed that authors in the

Global North generally studied the same FP2020 countries whereas authors in the Global South primarily conducted research on the countries in which they were located.

In the final stage of our analysis, we looked at the citation counts of articles in our database to determine whether the characteristics of higher publication rates presented in Figures 2, 5 and 6 translated to higher impact and greater attention from the scientific community. Citation analysis is a common and often criticized method (if used as a sole measure for research evaluation) in bibliometric analysis used to measure the scientific impact of research, particularly at the individual level (Ellegaard and Wallin 2015). However, it allows us to gauge the community's varying attention to specific publications. **Figure 8** presents the results of a negative binomial regression analysis with 3-year citation counts as our dependent variable.

The first model (family planning outcome) looks at the relationship between the three outcomes of interest (contraceptive use, non-use, unmet need) and 3-year citation counts to test whether there is a significant difference between these three groups. Published articles on contraceptive non-use and unmet need for family planning were less cited than contraceptive use, but neither of these results were statistically significant. The next two models introduced two dummy variables to test our assumptions about the effect of the number of countries studied and the number of authors. Single country studies represent the vast majority of articles in the database, however, they were cited significantly less than comparative multi-country studies. Solo-authored papers were cited less than co-authored papers.

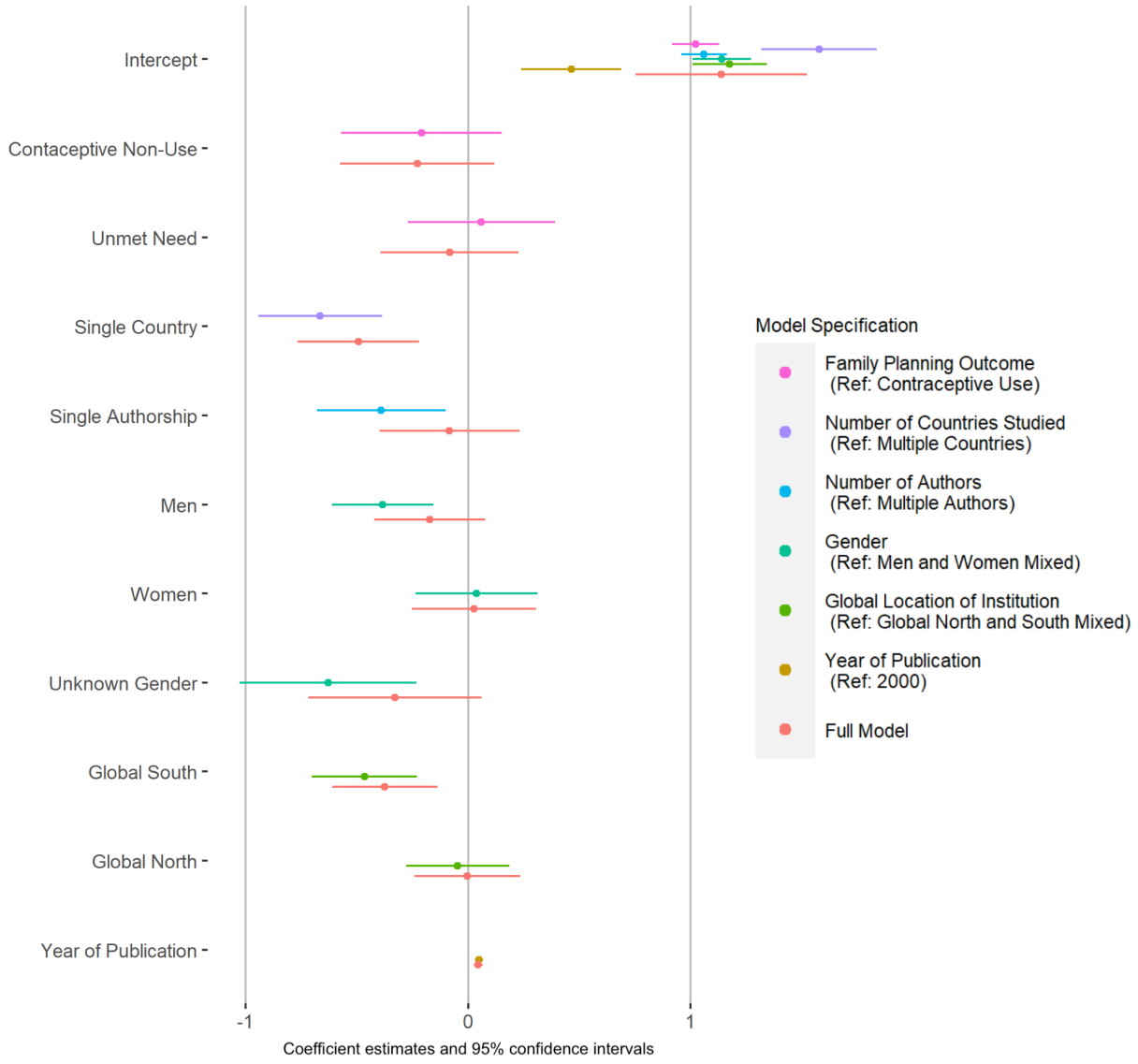

Figure 8. Negative binomial regression predicting article citation counts

Compared to collaborative research by men and women, research published by men received significantly fewer citations. Compared to collaborative research by Global North and Global South authors, research published by authors affiliated with Global South institutions received significantly less citations despite representing the largest group across determinants of family planning in our database. Further details on models presented in Figure 7 are presented in

Table A1 in the Appendix section. Our findings indicate that characteristics of higher publication rates, as shown in Figures 2, 4 and 5, do not necessarily translate to higher impact and greater attention from the scientific community.

Limitations

There are several key limitations to note in the design of this study. First, our scoping review excluded articles that were not published in English. The decision to restrict articles by language was based on the composition of the research team and capacity concerns, however, the inclusion of French and Spanish speaking FP2020 countries suggests that relevant articles were likely screened during the process. In addition, bibliometric databases that are searched usually cover a higher share of journals from the Western, educated, industrialized, rich and democratic (WEIRD) societies and English language. Furthermore, analyzing composition of authors in publications has an underlying assumption on independence of the observations. It could be violated due to shared authors between some publications in the sample. We included multiple dummy variables (e.g., single versus co-authored publications) in our models, but a better treatment would be using statistical models that are capable of considering relational structure of data and shared authorship into account (e.g., exponential random graph family of models (Lusher, Koskinen, and Robins 2013; Robins et al. 2007) (ERGMs) are well suited for this purpose) that could be an avenue of future research.

As previously stated, scoping reviews are also not designed to assess the quality or rigor of research. Our findings present patterns in the publication and citation of family planning literature based on key article and author characteristics. Our study is not designed to make claims about the quality of literature based on citation counts. In other words, we can not

conclude whether publications receiving more citations are more scientifically rigorous or deserving of attention from the scientific community.

Discussion

Our team reviewed the characteristics of literature on FP2020 countries published between 2000 and 2016 and used descriptive analysis to measure the distribution of articles by year (*when*) and geographic location (*where*). We found that contraceptive use was the family planning outcome most frequently studied each year. Studies on countries in Asia and Africa were published at a similar rate until 2008 when articles on African countries increased dramatically. Specifically, research was heavily concentrated in three FP2020 regions: Eastern and Central Asia, Eastern and Southern Africa, and Western Africa.

Our bibliometric analysis on the characteristics of authorship (*by whom*) found that most research is collaborative with teams of authors having the highest rates of publication across nearly all dimensions of family planning behavior (i.e. contraceptive use, non-use, and unmet need). The disproportionate number of co-authored papers in our database reflects the growing trend towards collaborative scientific research. The articles most represented in our database were written by teams of men and women co-authors. These articles also received greater attention from the scientific community compared to men and similar results relative to women. These are exceptional results in contrast to literature on other scientific fields (e.g., Sociology (Akbaritabar and Squazzoni 2021; Jacobs and Mizrachi 2020), Neurosciences (Dworkin et al. 2020), Political sciences (Teele and Thelen 2017), Management and organization journals (Auschra, Bartosch, and Lohmeyer 2022), to name a few) and shows that authors composition in family planning literature is more gender balanced.

Analysis of authors' geographic location showed that most research was produced by authors affiliated with institutions in the Global South. However, our citation analysis showed that this literature does not necessarily receive similar and more attention from the scientific community (i.e., citations). This finding, in combination with our descriptive analysis that showed collaborations among Global North and Global South teams are not rare in the family planning field, could signal a documented trend of an unequal division of labor similar to other fields (Boshoff 2009) where funding resources, computational platforms and data analysis happens in specific countries by some of the collaborators (usually Global North researchers) and the field work, data gathering and provision of study materials happen in Global South countries (Habel et al. 2014). The documented vicious circle of scientific impact can further penalize research done in the Global South as citations and impact evaluation affect future funding chances. This type of unequal division of labor could be evident in FP2020 programs where guidelines on family planning and contraceptive behavior are designed in specific countries with better resources and shared in a top-down and policy advice manner to the less resourceful countries.

According to Morgan and Lynch (2006), "science is a socially constructed way of 'knowing.' Its attractiveness is not its absolute accuracy, correctness, or usefulness, but its superiority to other ways of knowing" (p.36). The attractiveness of research in the field of family planning, as demonstrated through publication and citation, points to a preference for certain authorship characteristics over others, implicating concerns about knowledge diffusion disparities. Future research exploring other characteristics like author order or contributions to publications could offer deeper insights on patterns in knowledge production and diffusion that shape our understanding of family planning behaviors.

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Appendix

	Dependent variable: 3-year citation count						
	Outcome	Number of Countries	Number of Authors	Gender	Global Location	Year of Publication	Full Model
Family Planning Outcome							
Reference: Contraceptive Use							
Contraceptive Non-use	−0.210						−0.229
	(0.184)						(0.178)
Unmet Need	0.059						−0.083
	(0.169)						(0.158)
Number of Countries Studied							
Reference: Multiple Countries							
Single Country		−0.665***					−0.494***
		(0.142)					(0.140)
Number of Authors							
Reference: Multiple Authors							
Single Authorship			−0.390***				−0.083
			(0.148)				(0.161)
Gender							
Reference: Mixed Men and Women							
Men				−0.384***			−0.172
				(0.117)			(0.127)
Women				0.038			0.026
				(0.140)			(0.142)
Unknown				−0.630***			−0.330*
				(0.203)			(0.199)
Global Location of Institution							
Reference: Mixed North and South							
Geography: South					−0.466***		−0.374***
					(0.120)		(0.121)
Geography: North					−0.046		−0.004
					(0.118)		(0.122)
Year of Publication							
Year						0.050***	0.046***
						(0.010)	(0.010)
Constant	1.024***	1.578***	1.060***	1.141***	1.176***	0.464***	1.138***
	(0.054)	(0.132)	(0.052)	(0.067)	(0.086)	(0.115)	(0.197)
Observations	466	466	466	466	466	466	466
Log Likelihood	−1,011.184	−1,000.405	−1,008.548	−1,002.467	−1,002.991	−999.212	−976.452
Akaike Inf. Crit.	2,028.367	2,004.809	2,021.097	2,012.935	2,011.981	2,002.425	1,974.905
Note:							*p<0.1; **p<0.05; ***p<0.01

Table A1. Negative binomial regression models predicting article citation counts three years past publication with different set of fixed effects