Trends in Health Disparities, Health Inequity, and Social Determinants of Health Research

A 17-Year Analysis of NINR, NCI, NHLBI, and NIMHD Funding

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Background: The theoretical landscape of health disparities research now emphasizes health *inequities* and the role that social determinants of health (SDOH) play in creating and perpetuating them. Whether National Institutes of Health (NIH) funding patterns reflect this theoretical shift is unknown.

Objectives: The aim of this study was to examine the National Institute of Nursing Research's (NINR) funding for research focused on health disparities, health inequities, and SDOH, relative to other key NIH institutes.

Methods: Data on 32,968 projects funded by NINR, the National Cancer Institute, the National Heart, Lung, and Blood Institute, and the National Institute of Minority Health and Health Disparities (NIMHD) during the years 2000 through 2016 were downloaded from NIH RePORTER; those with health disparities, health inequity, or SDOH terms used in the abstract were identified. Descriptive statistics and a general linear model approach were used to assess differences in cumulative project counts and funding proportions, and funding trends over time.

Results: Overall, funding for health disparities projects was 14–19 times greater than for health inequity and SDOH projects and was more concentrated in centers and institutional training than in individual research projects. NINR's proportion of funding for disparities projects was consistently greater than that of the National Cancer Institute and the National Heart, Lung, and Blood Institute, but not for inequities and SDOH projects. NIMHD's proportion of funding for disparities, and inequities and SDOH projects (combined) was 2–30 times greater than that of other institutes. Over the 16-year period, funding for disparities, inequity, and SDOH projects each increased (all $ps < .05$); however, growth in inequities and SDOH funding was not evident in more recent years.

Discussion: Funding for projects focused on health equities and the SDOH lag behind theoretical shifts in the broader health disparities research arena. With the exception of NIMHD, there is a disconnect between funding for projects with a disparities orientation in institutional training and center projects relative to individual research projects. These trends have implications for nurse scientists seeking NIH funding to support health equity-oriented research.

Key Words: health disparities ● health inequities ● research funding ● social determinants of health

When we visit you
our clothes are ripped and torn
and you listen all over our naked body.
As to the cause of our illness,
a glance at our rags would be more
revealing.
One and the same cause wears out
our bodies and our clothes
_Bertolt Brecht, 1898 _1956
A Worker's Speech to a Doctor

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Health outcomes that differ by social and economic status have been observed for centuries, have demonstrated consistent patterns within and across diverse societies (Wilkinson, 1996), and are likely to continue to plague the moral and economic integrity of the United States and other areas of the world for the foreseeable future. Culminating from a movement led by epidemiologists across Europe in the 19th and 20th centuries, the first government-sponsored analysis of differences in mortality by social class was commissioned in Britain in 1977 (Gibbons, 2005). The findings, published as *The Black Report* (Black, 1980), prompted the genesis of a new area of research focused on population differences—or disparities—in health that would burgeon in Britain, the United States, and other countries over the 1980s and 1990s. During this period, the vast majority of research in health disparities was dedicated to documenting the existence of disparities by socioeconomic status and

race/ethnicity and eventually extended beyond mortality to a wider array of health outcomes across a number of disease states (Braveman, Egerter, & Williams, 2011).

In addition, provocative questions within the scientific community were eliciting a more critical appraisal of the etiologies of and the array of biopsychosocial mechanisms that contribute to health disparities. A notable metaphor in epidemiology, the "web of causation" was revived in an article by Nancy Krieger (1994), in which she shrewdly asked: "has anyone seen the *spider* [emphasis added]?" (p. 887). Advancing this metaphor raised questions around the root systemic causes of health disparities that extended beyond proximal or behavioral causes. This spawned a wave of theory development in health disparities research, where extant theories were either applied in novel ways, such as general systems theory (von Bertalanffy, 1968) and socioecological frameworks (Milio, 1987), or emerged in new forms, such as the allostatic load model (Seeman, Singer, Rowe, Horwitz, & McEwen, 1997). These theoretical advances contributed to a growing understanding of the multifactorial etiology of health disparities and the various types of mechanisms that explain how social and economic disadvantage exerts physiological effects that "get under the skin" (McEwen, 2002) or become "embodied" (Krieger, 2005)—resulting in a higher prevalence of disease at the population level. Whether federal agencies funding most of the research in the United States have kept pace to support the empirical research needed to test theoretical advances around root causes, multifactorial etiologies, and mechanisms of health disparities that could be addressed through broad-based, cross-sector (i.e., not solely within the health system) interventions remains an open question.

Nursing too has a long history of concern for the health of all, but particularly for those living in conditions of deprivation (Reutter & Kushner, 2010). This history begins with Nightingale and extends to today's nurse practitioners and scientists as they advance theoretical perspectives on health disparities (Yanicki, Kushner, & Reutter, 2015), change practice to improve the health and well-being of the underserved (Sanchez-Birkhead, Carbajal-Salisbury, Arce Larreta, Hendricks, & Beck, 2016), and test interventions designed to address environmental factors that impede health (Froelicher, Doolan, Yerger, McGruder, & Malone, 2010). Tackling health disparities has been an integral part of the discipline (Yanicki et al., 2015), with equity a key component of nursing practice (as encoded in the American Nurses Association's Code of Ethics; American Nurses Association, 2015) and as prime import for nursing research (Henly, 2016). As nurse scientists with interests in eliminating health *inequity* by addressing the social determinants of health (SDOH), the central purpose of the work presented here is to assess how funding patterns from the National Institutes of Health (NIH) institute designated to represent nursing's disciplinary perspective—the National Institute of Nursing Research (NINR)—compares to other relevant NIH institutes in supporting research that addresses health inequities. The National Cancer Institute (NCI) and the National Heart, Lung, and Blood Institute (NHLBI) are used as comparison groups for NINR, given that NCI and NHLBI regularly seek applications for health disparities-related research (National Institutes of Health, 2017b). The National Institute of Minority Health and Health Disparities (NIMHD) was also selected as a comparison, given its designation as the institute to focus on health disparities. Thus, the pattern of funding by NIMHD reflects what would be expected to be the highest proportion or "ceiling" level of funding for health disparities-related research within the NIH.

This article begins with a review of the evolution in theoretical thinking in the broader health disparities-related literature. More specifically, this evolution reflects a shift in the conceptual distinctions between and the recommendations for use of the following key terms: *health disparity*, *health inequity*, and *social determinants of health*. Next, using these key terms, we empirically examine whether observed funding patterns of NINR, relative to NCI, NHLBI, and NIMHD, parallel these theoretical shifts. Based on the findings, the implications the funding patterns have for reducing health inequities through nursing science are discussed, including implications for training future nurse scientists and establishing programs of research that seek to reduce health inequities by addressing the SDOH.

THEORETICAL SHIFTS: REFLECTIONS IN TERMINOLOGY

Trends in the development of theories that describe and explain health disparities are reflected in the evolving terminology used in the health sciences. As Braveman and colleagues note, semantic differences in using the terms health *disparities* versus health *inequities* and an agreed upon understanding of the meaning of SDOH are not merely academic or technical concerns (Braveman, Arkin, Orleans, Proctor, & Plough, 2017). Rather, these terms are grounded in different ethical and justice narratives (Braveman, 2014) and have "important policy implications with practical consequences" (Braveman, 2006, p. 168). An overview of these narratives is offered in the section that follows, whereas comprehensive accounts can be found elsewhere (Beauchamp, 1986; Braveman, 2006, 2014; Penman-Aguilar et al., 2016).

The term *health disparity* (sometimes referred to as a health *inequality*) depicts *any difference* in health outcomes across population subgroups—regardless of causal attributions (Braveman, 2014; Carter-Pokras, 2002). These differences may or may not be associated with differential access to social and/or economic resources. For example, there are clear differences by race in the prevalence of sickle cell disease; however, whether an individual acquires sickle cell disease is determined by inheriting a genetic mutation, rather than his or her access to resources or socioeconomic status.

Greater morbidity and higher rates of early mortality among individuals with sickle cell disease, on the other hand, are associated with differential access to healthcare resources (McClellan et al., 2012) and socioeconomic status (Aljuburi et al., 2013). All of these differences represent "health disparities"— yet, the latter example reflects disparities that can likely be avoided based on the distribution of and access to resources at the societal level. When applied to each of these different scenarios, referencing these differences in health outcomes as a "health disparity" is conceptually void, or mute, on whether the differences are ethical or avoidable.

In contrast, ethical judgment is embedded in the term *health inequity*, where the implications are that some health disparities result from differential access to social and/or economic resources and that this differential access is "avoidable, unfair, and unjust" (Braveman, 2006, p. 169). Put another way, disparity terminology allows for embracing divergent justice-oriented stances about unequal access to social or economic resources. Although concern for public health remains central, embracing a *health disparity* perspective does not preclude an acceptance that unequal access to resources may occur through a market justice-oriented distribution system (Beauchamp, 1986), in which avoiding health problems is primarily an individual's responsibility. *Health inequity* aligns with a social justice orientation that, in turn, supports a system of distributing resources to ensure that "no one is denied the possibility to be healthy [because they belong] to a group that has historically been economically/socially disadvantaged" (i.e., a more societal or population-level approach; Braveman, 2014, p. 6). Thus, to claim a difference in health outcomes is an *inequity*, as currently conceived, is to simultaneously claim that principles of social justice are being violated, *and* that actions are needed to either prevent and/or remedy this difference because it is unjust (Beauchamp, 1986).

Alone, neither of the terms *health disparity* nor *health inequity* clearly points to a unit of analysis needed in research to understand the etiologies of population differences in health or the level at which we should target interventions. For example, are efforts to be targeted at the individual level (e.g., eating behaviors), the socioeconomic context in which individuals live (e.g., fresh vegetable availability and affordability in neighborhoods), or some weighted combination of both? Prevailing theories in health disparities research are clear that both are needed (Braveman et al., 2011). For some, a focus on health behavior at the individual level to explain and address disparities is inadequate and calls for tackling the "causes of [individual or behavioral] causes" or "root causes"—referred to as SDOH (Marmot, 2013, p. 11). Simply put, SDOH are defined as "conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality of life outcomes" (U. S. Department of Health and Human Services, 2010, p. 1). The increasing emphasis on SDOH in more recent theories (such

as socioecological theory) implies that, to address health inequities, scientists must study—as explanatory variables and/or intervention targets—the *conditions* in which people live and not solely individual responses to these conditions.

Because the theoretical basis informing research on health disparities has evolved to become a health equity framework focused on the SDOH, it could reasonably be expected that, over time, the funding patterns of the NIH and its institutes would reflect this shift for science to advance and ultimately improve the nation's health. Without funding support that "centers" equity and the SDOH, research to test theories and/or interventions on the SDOH will not be fully realized. Therefore, the purpose in conducting this inquiry is to empirically analyze the extent to which funding of projects by NINR, relative to other select NIH institutes (specifically, NCI, NHLBI, and NIMHD), reflects the theoretical shift toward health inequity and SDOH that has evolved in the field of health disparities research since 2000.

METHODS

Search Criteria

Theoretical advances and accompanying shifts in disparities-related terminology began occurring in the early 2000s, which marked a number of progressive events that catalyzed health disparities research. NIH project funding data from fiscal years 2000 through 2016 were selected for inclusion, given key events that occurred to advance health disparities research over this time—namely, the goals set forward in *Healthy People 2010* and *Healthy People 2020*, and legislation that established the National Center on Minority Health and Health Disparities, which would later become NIMHD (National Institutes of Health, 2017a; U.S. Department of Health and Human Services, 2000, 2010). Using the NIH Research Portfolio Online Reporting Tools (RePORTER) search engine and a priori-defined criteria, a search was conducted for records of awarded grants from NINR, NCI, NHLBI, and NIMHD within this time frame. Only "new" projects were selected within the RePORTER *Award Type* search options. For each target institute, the search for new projects included (a) non-small business innovation research/small business technology transfer research *research project grants* and (b) *centers and training grant* funding mechanisms. The *research project grant* search category within RePORTER included the following activity codes: P01, R01, R01 equivalents (DP2, R23, R29, R37, RF1), R03, R15, and R21 grants. The *centers and training grant* search category within RePORTER included the following: M01, P20, P30, P41, P50, P60, U54, UL1, F30, F31, F32, F33, F99, T32, T35, T90, TL1, TL4, and TU2 awards.

Measures

Outcome variables of interest included project counts and funding amounts, and the proportions of each separately, by

the levels of the categorical explanatory variables (described below). *Project count* reflects the sum of the number of projects, generated from the administering institute/center (IC) and project identification codes downloaded from NIH RePORTER. Only awards for "new" projects were included in the project count; thus, continuing renewal projects were not included. *Funding amounts* were calculated using only the total of the first year of funding allocated to each project. Only the first year of funding was included in order to standardize the number of funding years represented and to avoid artificially inflating funding across the 17-year span of time. For example, by taking this approach, the funding total of a 5-year project funded from the years 2000 through 2005 would not be overinflated when compared to a 5-year project that began in 2015, but that would only have 2 years of funding represented in the data (all data span only from the years 2000 through 2016). Funding amounts for individual research projects (IRPs) and individual training grants include direct and indirect project costs; for *research centers* and *institutional training* mechanisms, funding amounts also include subproject costs.

Explanatory variables reflect search domain, NIH institutes, project mechanisms, and fiscal year(s). *Search domain* includes three mutually exclusive categories, which identify projects with the terms "health disparity/disparities," "health inequity/inequities," or "social determinants of health" in the abstract text. Categories of the *NIH institute* variable include NINR, NCI, NHLBI, and NIMHD. *Project mechanisms* include four mutually exclusive categories of award types defined by "activity code" indicators in the RePORTER data. The four project mechanisms include IRPs (includes activity codes P01, R01, R01 equivalents [DP2, R23, R29, R37, RF1], R03, R15, and R21 award types), research centers (includes activity codes M01, P20, P30, P41, P50, P60, U54, UL1), institutional training (includes activity codes T32, T35, T90, TL1, TL4, and TU2 awards), and individual training (F30, F31, F32, F33, F99). The *fiscal year* variable included each year from 2000 through 2016 and represents the first year in which a new project was awarded funding. For select analyses, fiscal years were grouped to represent three time periods (the years 2000–2005, 2006–2010, and 2011–2016), which facilitated identification of differences in trends over time.

Data Extraction and Cleaning

Data extraction and cleaning included exporting data from NIH RePORTER into comma-separated values files and then importing the data into Stata/SE Version 13.0 (StataCorp LLC, 2017) as well as SAS/STAT Version 9.4 (SAS Institute, 2017). An algorithm that details the disposition of all 36,174 downloaded records is provided in Figure 1. Of all records retrieved, data were missing on the *administering IC* and all other relevant variables of interest for 15 records. Empty ($n = 15$) and duplicate records within project identifiers ($n = 3,206$) were

removed. Funding for only one subproject appeared to be misclassified (within an NCI R01); given that subprojects are not typically funded through R01 mechanisms, the subproject amount for this single observation was recoded to zero.

Analyses

Descriptive statistics were used to calculate both the frequencies and percentage of total projects and funding allotted to projects within NIH institutes, each search domain, and mechanism. Because there were no observations in several of the inequity and/or SDOH domains within select mechanisms, the cumulative proportion of funding across inequities and SDOH search domains (I+SDOH) and CIIT (combined research center, institutional training, and individual training) mechanisms are also presented.

To assess year-to-year trends in funding patterns for the years 2000 through 2016, we statistically examined the means of these funding proportions, over time, using a general linear model (GLM) approach. The main effects GLM is specified in equation $E(y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$, where y is the respective dependent variable, X_1 is an indicator for IRPs as the mechanism, and X_2 and X_3 are indicators for fiscal years 2006–2010 and 2011–2016, respectively. Separate GLMs were specified for each of the dependent variables for percent funding for health disparities, percent funding for health inequities, and percent funding for SDOH. Within institutes and funding mechanisms, funding for each search term domain was sporadic across the years observed (see Supplemental Digital Content 1, http://links.lww.com/NRES/A297, Figures A, B, and C). Given this, for these GLMs, the dichotomous funding mechanism variable was used (IRPs, CIITs) as was the grouped fiscal years of 2000–2005, 2006–2010, and 2011–2016 to indicate time period. For each of the GLMs, the dichotomous funding mechanism and the grouped fiscal year variables were included as explanatory variables in both the main effects model as well as the model that added their interaction. Residuals from these models were examined as regression diagnostics, and the following transformations were assessed: logarithm, log–log, square root, and arcsine. If the mechanism-by-time period interaction was not significant at a .05 alpha level, it was removed, and the main effects model was preferred. Pairwise differences among the three time periods, with a Tukey's adjustment to account for multiple comparison, were examined; a formal statistical test was also applied within the GLM framework to examine whether there was a linear trend across the three sequential time periods at the two-sided .05 significance level.

RESULTS

Cumulative Projects and Funding Frequencies of the cumulative number, amount, and percentage of project awards from the years 2000 through 2016 are presented by institute, mechanism, and search domains in Table 1. In addition, detailed counts of project activity codes (R01, P20, etc.) that
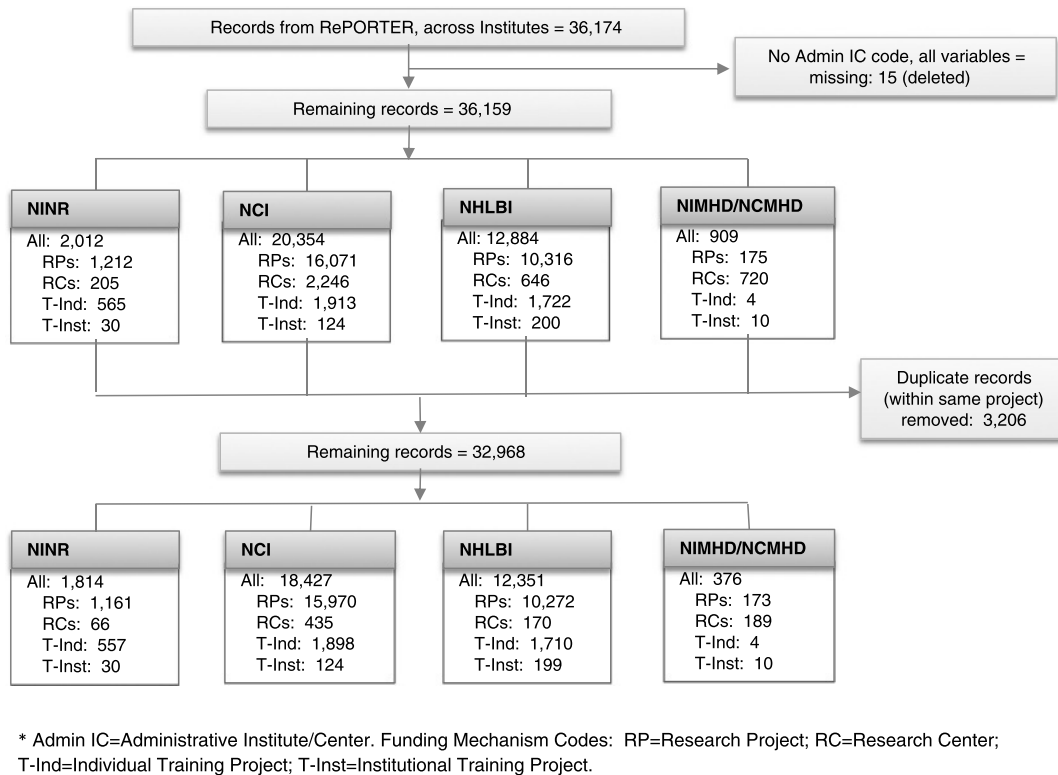
* Admin IC=Administrative Institute/Center. Funding Mechanism Codes: RP=Research Project; RC=Research Center;
T-Ind=Individual Training Project; T-Inst=Institutional Training Project.

FIGURE 1. Project records search and disposition algorithm.

comprise each of the four mechanisms are provided in Table A (see Supplemental Digital Content 2, http://links.lww.com/NRES/A298), by institute. A clear pattern in both the cumulative number of projects funded as well as the proportion of funding within search domains was noted. The percentage of funding for NINR projects in the health disparities domain was more heavily concentrated in research centers (34.7%) and institutional training (31%) mechanisms, as compared to individual training (15.1%) or IRP (12.3%) mechanisms (see Table 1). The distribution of funding for NCI and NHLBI across mechanisms was similar. These general patterns of greater percent funding for research centers and institutional training relative to individual training and IRP mechanisms in projects belonging to the inequity and/or SDOH domains by NINR, NCI, and NHLBI were also observed. Notably, across the entire 17-year observation period, no projects were funded in the inequity and/or SDOH domains in at least one mechanism within each institute, including research centers (NINR), institutional training (NINR, NCI, NIMHD), and individual training (NINR, NHLBI, and NIMHD) mechanisms (see Table 1).

Given the many categories of descriptive findings presented in Table 1 and the number of inequity and/or SDOH domains with zero projects funded, a more condensed and easily interpreted summary of funding proportions within and across institutes is provided in Table B (see Supplemental Digital Content 2, http://links.lww.com/NRES/A298) and highlighted in Figure 2, which depicts combined funding amounts for research centers, institutional training, and individual training mechanisms (i.e., CIIT) and inequities and SDOH domains (i.e., I+SDOH). Within this more condensed version of the data, the proportion of funding for disparities projects was 14 times greater than I+SDOH projects within CIITs, and 19 times greater within IRPs. Within each institute, the percent funding awarded to disparities projects was greater than that awarded to I+SDOH projects for both CIIT and IRP mechanisms. Specifically, for CIITs, the disparities percent funding ranged from 6.8% (NHLBI) to 95.5% (NIMHD) relative to an I+SDOH funding range of 1.1% (NINR and NHLBI). For IRP mechanisms, the disparities project percent funding ranged from 2.6% (NHLBI) to 80.4% (NIMHD), relative to an I+SDOH range of 0.12% (NHLBI) to 8.9% (NIMHD). Also within each institute, the percent funding for disparities projects within CIIT mechanisms was at least twice that of IRPs, indicating disparities project funding is concentrated within the research center, individual training, and institutional training mechanisms. With respect to I+SDOH projects within NINR, NCI, and NHLBI, funding was ≤1% higher for CIITs relative to IRPs and on a much smaller overall scale (ranging from NHLBI's low of 0.12% for I+SDOH IRPs to a NIMHD's high of 8.9% for I+SDOH IRPs). Unlike the other institutes reviewed, NIMHD's IRP percent funding for I+SDOH projects exceeded that of CIIT funding, albeit only by 0.6% (8.9% for IRPs, 8.3% for CIITs).

Differences in funding proportions across institutes were more variable. Overall and not unexpectedly given its mission,

TABLE 1. Research Projects and Funding Amounts, by NIH Institute, Search Domains, and Specific Mechanism: 2000–2016

NIH Institute Mechanism	All projects		Disparity/disparities				Inequity/inequities				Social determinants			
			Projects		Funding		Projects		Funding		Projects		Funding	
	n	Funding	n	%	Total	%	n	%	Total	%	n	%	Total	%
NINR														
Individual research projects	1,161	388,957,856	143	12.3	48,175,124	12.4	4	0.3	1,769,951	0.5	1	0.1	353,198	0.1
Research centers	66	21,973,460	27	40.9	7,631,326	34.7	0	0	0	0	0	0	0	0
Training: institutional	30	4,891,862	9	30	1,514,921	31	0	0	0	0	2	6.7	252,880	5.2
Training: individual	557	18,721,168	82	14.7	2,827,851	15.1	3	.5	99,586	.5	4	.7	157,374	.8
NCI														
Individual research projects	15,970	4,572,601,856	520	3.3	156,252,176	3.4	14	.1	4,664,767	.1	7	.04	1,924,251	.04
Research centers	435	537,388,928	111	25.5	68,773,840	12.8	5	1.2	3,875,767	.7	4	.9	5,447,478	1.0
Training: institutional	124	23,420,480	8	6.5	1,701,922	7.3	0	0	0	0	0	0	0	0
Training: individual	1,898	76,132,296	35	1.8	1,220,392	1.6	0	0	0	0	1	.05	35,602	.05
NHLBI														
Individual research projects	10,272	4,165,456,896	193	1.9	108,564,072	2.6	4	.04	1,854,773	.04	5	.05	3,143,201	.1
Research centers	170	227,920,928	16	9.4	19,968,092	8.8	1	.7	1,277,749	.6	1	.6	1,992,210	.9
Training: institutional	199	33,193,268	6	3.0	1,499,359	4.5	1	.5	253,017	.8	0	0	0	0
Training: individual	1,710	74,357,984	31	1.8	1,401,748	1.9	0	0	0	0	0	0	0	0
NIMHD														
Individual research projects	173	71,580,624	143	82.7	57,653,600	80.4	5	2.9	2,516,679	3.5	12	6.9	3,891,507	5.4
Research centers	189	178,101,952	163	86.2	169,997,424	95.5	7	3.7	7,183,691	4.0	7	3.7	7,626,372	4.3
Training: institutional	10	0	3	30	0	0	0	0	0	0	0	0	0	0
Training: individual	4	144,592	4	100	144,592	100	0	0	0	0	0	0	0	0

Note: NIH RePORTER search term selection through December 31, 2016 = "New Projects." Search criteria "Research Project Grants," "Non-SBIR/STTR." Centers and institutional training search criteria included "research centers" and "training." Project counts based on number of individual identifiers within administrative institute/center (IC) codes; subprojects within research centers not included as independent awards. Cumulative funding amounts reflect only the first year of funding for new projects and not subsequent continuation years or competing renewals. Funds for projects received through an NIH IC that differs from the administering IC are not included in funding totals within the target administrative IC. Funding amounts in U.S. dollars. NIH = National Institutes of Health; NINR = National Institute of Nursing Research; NCI = National Cancer Institute; NHLBI = National Heart, Lung, and Blood Institute; NIMHD = National Institute of Minority Health and Health Disparities.

NIMHD's percent funding of health disparities and I+SDOH projects within the IRP mechanism was 13 and 30 times that of the mean of NINR, NCI, and NHLBI's (combined) percent funding of I+SDOH IRPs, respectively. These differences
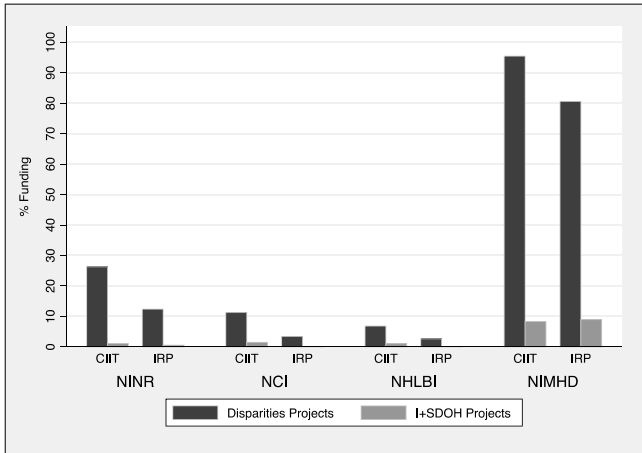
CIIT = Research Centers, Institutional Training, and Individual Training combined project funding percent.
I+SDOH = Inequity and SDOH domain combined project funding percent. All funding amounts based on Year 1

FIGURE 2. Condensed funding proportions by NIH (National Institutes of Health) institute, mechanism, and research area: 2000–2016.

narrowed for CIIT project funding, where NIMHD's percent funding was fivefold and twofold greater than the mean of NINR, NCI, and NHLBI (combined) health disparities and I+SDOH projects, respectively.

For NINR specifically, the proportions of funding awarded to health disparities projects in the IRP (12.3%) and CIIT (26.3%) mechanisms were greater than that awarded by NCI (3.4% for IRP, 11.3% for CIIT) and NHLBI (2.6% for IRP, 6.8% for CIIT). The higher proportion of funding that was observed in disparities projects for CIIT mechanisms relative to IRP mechanisms across NINR, NCI, and NHLBI did not hold for I+SDOH projects, however, where the proportion of funding by NINR, NCI, and NHLBI within CIIT and IRP mechanisms were all 1.5% or less. Not surprisingly, NIMHD's percent funding for disparities (80.4% for IRPs, 95.5% for CIITs) and I+SDOH projects (8.9% for IRPs, 8.3% for CIITs) exceeded the funding awarded by NINR in the same funding mechanisms and search term domains.

Funding Trends Over Time Figures A, B, and C (see Supplemental Digital Content 3, http://links.lww.com/NRES/A297) show the sporadic funding patterns for health disparities, health inequity, and the SDOH projects by institute and funding

mechanism. Figure 3 is specific to NINR and plots the percent funding for each research area by year and funding mechanism. Visually and consistent with the national interest in health disparities emerging at the time, Figure 3 shows a very high percentage of funding going to research centers for projects in the health disparities domain early in the time period (approximately between the years 2000 and 2005), but with a continued plateau at relatively high levels (between 30% and 40%) up to 2013. The only notable increases in more recent years were for SDOH- and health disparities-oriented projects, which essentially co-occurred within the institutional training mechanism between the years 2013 and 2016. For all three domains of interest, the percent funding within the individual training and IRP mechanisms was minimal and fairly constant by year (Table 2).

In GLMs for each search domain (health inequities, health disparities, and SDOH), the mechanism-by-time period interaction was found to be nonsignificant, and this interaction was dropped from the model. Thus, trends in funding within search term domains over time were not statistically different for IRPs and CIITs. The resulting main effects models revealed nonsignificant mechanism effects (implying no significant differences between IRPs and CIITs). The main effects models did show significant overall time period effects for health inequities and health disparities, but not SDOH ($p = .08$). Formal testing of pairwise differences for funding in each of the health inequities and health disparities domains indicated a significant difference between the time periods of 2000–2005 versus 2011–2016. Significant increasing linear trends over these time periods were also found for health inequities and health disparities, as well as for SDOH. Although the regression diagnostics of the residuals for these GLMs indicated violation of some model assumptions, a sensitivity analysis of GLMs across a number of transformations of the dependent variable revealed a pattern of findings that were consistent across models, though the regression diagnostics for these GLMs were not substantially improved (see Supplemental Digital Content 3, http://links.lww.com/NRES/A296).

DISCUSSION

Overall, the findings suggest that patterns of funding by the NIH institutes examined do not, as yet, reflect contemporary theoretical thinking in the broader field of health disparities research. As such, one implication for research and nurse scientists is that the way they are being asked to address health inequities through interventions targeting the SDOH may be lagging behind theoretical advances made more broadly. Such a lag may be expected given that, across fields, theoretical advances typically precede theory testing, as well as developing and testing theory-derived interventions (Painter, Borba, Hynes, Mays, & Glanz, 2008). With this caveat in mind, there was a significantly greater proportion of funding in all NIH ICs examined that went to projects using the terms *health disparity* or *health disparities* compared to those using *health inequity* or *health inequities*, or *SDOH* to describe the nature

NINR Funding of Health Disparity, Health Inequity, and SDOH Projects
by Project Type & Fiscal Year (FY)
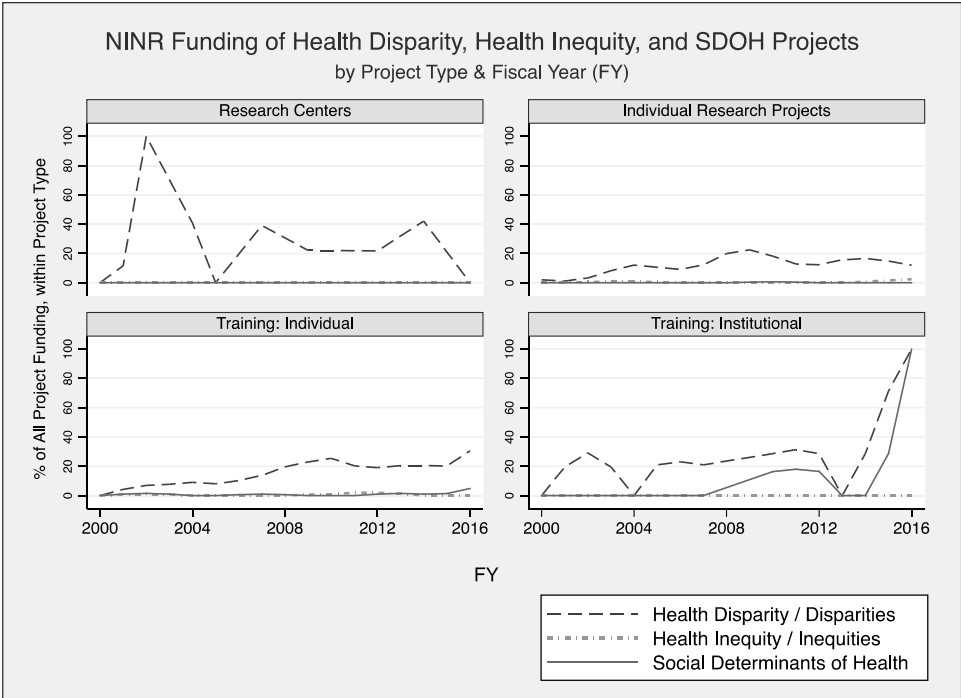
Low bandwith lowess smoothed line; first year of project funding, new projects only.

FIGURE 3. National Institute of Nursing Research: Percent funding by research area, project type, and year.

TABLE 2. Parameter Estimates (Standard Errors) From Main Effects Regression Models for Untransformed Dependent Variables

	Dependent variable		
	% Health disparity/ disparities funding	% Health inequity/ inequities funding	% Social determinants of health funding
Parameter	Estimate	Estimate	Estimate
Intercept	11.3** (3.7)	0.1 (0.3)	0.4 (1.0)
Mechanism: individual research projects	−3.3 (4.6)	−0.1 (0.4)	−0.8 (1.2)
Mechanism: centers/institutes/training	Reference	Reference	Reference
Fiscal years 2000–2005	Reference	Reference	Reference
Fiscal years 2006–2010	8.7 (5.2)	0.1 (0.5)	0.4 (1.4)
Fiscal years 2011–2016	15.0** (4.9)	1.1* (0.4)	2.7* (1.3)
Linear trend across time periods	$p = .002$	$p = .010$	$p = .037$

$*p < .05. **p < .01. ***p < .001.$

of the scientific work. This funding pattern was evident over the longer 17-year period and did not change across more recent time periods (specifically between the periods 2006–2010 and 2011–2016), suggesting a recent upward trend in funding toward projects specifically focused on inequities and/or SDOH has not occurred.

These results also have implications for research training and development of the next generation of scientists, as well as more broadly for the contributions nursing science can make to eliminate health inequities. First, between the years 2000 and 2016, the NIH made considerable investments through the research center and training grant mechanisms in preparing future scientists and developing new investigators to conduct research around health disparities. Among the institutes included in this analysis, NIMHD and NINR have invested the greatest proportion of funding in research center and research training mechanism-based projects in the health disparities domain relative to their budgets. This suggests that a cadre of scientists (including, but not limited to, a cadre of nurse scientists) is poised to conduct health *disparities* research but may be less prepared to conduct research that targets health inequities and/or the SDOH. These trends could be attributed to several factors: (a) a shortfall of applications that are sufficiently meritorious to be competitive for funding in the health equity or SDOH domains, (b) calls for proposals that use the term *health disparities* more frequently than *health inequities* or *SDOH*, or (c) other as yet unidentified factors in the review and funding selection process. To better align scientific funding with theoretical advances in the field that emphasize health inequities and a focus on SDOH, further inquiry to understand what factors are driving these patterns is worth pursuing.

Second, trends revealed in this analysis may also mean that the "time to R-level research project funding" could be longer for junior scientists who were supported by institutional and/or individual training awards with a health disparities, health inequity, or SDOH focus as compared to those supported by training awards without one of these focal areas. A mismatch exists between the proportions of funds that the selected

institutes have invested in health disparities, health inequity, and/or SDOH research training as compared to the proportions allocated to what should follow such investment (i.e., funded IRPs that address health disparities, inequity, and/or SDOH). For NINR, 27.4% of all research center, institutional training, and individual training funds went to health disparities, health inequities, or SDOH projects (combined), whereas only 13% was allocated to IRPs (i.e., R01, R03, R15, R21, R01 equivalents). With the exception of NIMHD, institutional investments in training and research center awards focused on health disparities, or health inequities and SDOH (combined) have surpassed their investments in IRP projects (i.e., R01, R03, R15, R21, R01 equivalents). This finding suggests that the NIH may have not capitalized to the extent it could have on investments in research training or the work conducted by teams within the research center mechanisms by making similar investments in IRP projects in these domains.

Particularly for junior faculty, one of the most critical steps in grant submission is deciding which NIH institute is the best fit for the proposed research (Conn et al., 2017)—a decision largely guided by understanding the various institutes' research priorities and funding patterns. Our findings may be particularly useful for beginning scientists as they navigate the complexity of research proposal submission decision-making. Although our analysis largely emphasizes trends in funding proportions in select focal areas (rather than differences in absolute project counts), fundamentally, funding reflects the institutional commitment and acceptability of framing research problems related to health disparities, health inequity, and SDOH. At present, this is extremely important to consider in the grant submission process, as competition for funding is approaching an all-time high (Powell, 2017).

On the broader scientific front, after two decades of burgeoning health disparities research and a commitment to reduce health disparities in the NIH strategic plan and/or mission statements (National Institutes of Health, 2015), efforts to significantly reduce most health disparities in the United States have failed (Institute of Medicine, 2012). This may be,

in part, because the vast majority of disparities in health reflect *inequities* that, at the population level, are widely believed to result from differential access and/or exposure to a wide array of determinants that are structurally embedded in socially constructed, socially sanctioned, and socially enforced systems (criminal justice systems, economic and labor systems, etc.). Most of these social determinants are viewed as falling outside the purview of the "healthcare" system and have indirect and often lagged effects on health (Galea & Vaughan, 2017); yet, research initiatives within NIH, generally, and NINR, more specifically, remain predominantly directed at the individual level of care that can be provided through clinical health systems (National Institute of Nursing Research, 2016; National Institutes of Health, 2015). These realities pose ideological and methodological challenges to meeting the goal of eliminating health inequities in the United States (U.S. Department of Health and Human Services, 2010).

Ideologically, the allocation of resources to support health has been a topic of intense debate in the United States. The present approach of focusing on individual behaviors has had limited effect on reducing health inequities, and new approaches are needed, such as attending to the SDOH (Yanicki et al., 2015). Although it is unknown if addressing the SDOH will result in eliminating health inequities, it will remain unknown unless the emergent theories in the field of SDOH are tested through empirical work. Funding that provides future nurse scientists and new investigators with the requisite training, experiences, and skills for conducting research on health inequities and the SDOH will be needed to achieve the empirical work to be done. In addition, for more seasoned investigators, funding research projects that test contemporary theories and/or develop and test multilevel interventions based on these theories is also necessary (Schulz et al., 2011). As such, one recommendation includes wording funding opportunity announcements that explicitly call for the proposed research to address SDOH in health equity-oriented research. Furthermore, funding opportunity announcements that encourage collaboration between nurse scientists who address health problems at population and/or individual levels and nurses with practical knowledge of the multilevel factors that underlie health inequities in community and clinical settings could advance research on health inequities and the SDOH.

Limitations

This work has two notable conceptual and methodological limitations. First, three designated search terms (disparities, inequities, and SDOH) to identify relevant funded projects are imperfect indicators for determining the actual focus of a particular project. It is not clear, for example, whether researchers' use of a particular term (disparities, inequities, SDOH) within the abstract text of a grant proposal actually reflected current theoretical trends. Although applying a content analysis approach (and consequently, a more refined coding scheme) would likely have provided a more accurate determination of a project's focus, this was not feasible given the time span of interest and the sheer volume of project records reviewed (>32,000). Given these constraints, the assessment of funding patterns conducted here should be considered exploratory in nature and reflective of how these terms are applied within the scientific community, rather than an account of the accuracy of their use. Because the NIH RePORTER database provides information only on funded applications and not submitted applications, the ability to understand the patterns or proportions of funding in each search term area relative to the number of applications submitted for funding was limited. As such, it may be the case that many more applications submitted within each search term area are funded relative to applications focused in other areas (or vice versa). Despite these search limitations, the search terms used were deemed reasonable proxies for identifying and categorizing projects. In addition, using the public data available (even if limited in scope) allowed an exploratory analysis of funding patterns relative to these areas to be conducted.

Second, the fairly inconsistent and sporadic pattern of projects funded year-to-year—where many institutes had no funding of inequity and SDOH projects in several funding mechanisms for any of the observed years—required that data were collapsed across years, within search terms, and within funding mechanism categories to statistically analyze key differences of interest. Collapsing data in this way led to some loss of specificity but allowed moving beyond a purely descriptive account of longitudinal funding patterns to conducting formal statistical tests of the trends in funding over time.

CONCLUSION

Nurse scientists have focused on reducing health disparities by improving the healthcare provided to individuals who are socially or economically disadvantaged and have made a number of scientific contributions on this front (Breitenstein et al., 2012; Jemmott, Jemmott, & O'Leary, 2007; Kaiser, Thomas, & Bowers, 2017; Kneipp et al., 2011). These efforts have been supported by NINR allocating a higher proportion of funding to health disparities projects over the past several years. Nurse scientists need to continue their work in making contributions that can close the health disparities gap in the United States; however, doing so necessitates situating research efforts within a health *equity* framework that incorporates the SDOH and committing funding to realize these endeavors.

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