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ARTICLE

Seeking racial and ethnic equity among neonatologists

Eric Horowitz[1] · Mihail Samnaliev[2] · Renate Savich[3]

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Abstract

Objective Racial and ethnic inequities in leadership achievement, compensation, scholarly productivity, and grant funding exists among physicians. This study explores whether similar inequities exist among neonatologists within the United States.

Study design A voluntary anonymous survey was distributed to members of the American Academy of Pediatrics Section on Neonatal–Perinatal Medicine with 560 respondents. Logistic regression and ordinary least squares were used to assess whether racial and ethnic identity is associated with clinical time, leadership, compensation, publication, grant funding, or academic rank.

Results As compared to non-Hispanic White neonatologists, statistical differences were found for underrepresented minorities in medicine in: regions of the country where they worked, total cash compensation received, being awarded an NIH grant, and location of graduate medical education. Fewer differences were found for Asian neonatologists and included location of graduate medicine education.

Conclusion Racial and ethnic identity remains a significant independent factor influencing professional achievement and compensation.

Introduction

For over 50 years, since the American Association of Medical Colleges established the Office of Minority Affairs in 1969, systems have been working to improve the diversity of the physician work force [1]. Several authors have explored issues of diversity, and organizations have released diversity statements [2–17]. These efforts have also led to the recognition that the definition of diversity needs to expand to include the concepts of race, ethnicity, language, national origin, immigration status, ancestry, gender identity or expression, sexual orientation, religious beliefs, and disability [17]. With these efforts, for the purpose of better understanding racial and ethnic diversity, the term underrepresented in medicine (UIM) has been coined to include those who identify as American Indian or Alaska Native, Black or African American, Hispanic or Latino, and Native Hawaiian or Other Pacific Islander as defined by the US Census Bureau [18, 19]. Further the Association of American Medical Colleges has come to define UIM as "…those racial and ethnic populations that are underrepresented in the medical profession relative to their number in the general population" [20].

Despite these systemic efforts that have led to an increase in the number of those UIM, this growth is being outpaced by their relative growth within the general United States population resulting in a relative contraction of UIM [9, 17, 21, 22]. Further, specific to pediatrics, while in 2018 the US population consisted of 60% non-Hispanic White, 6% Asian (including a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent), and 34% UIM; the AAMC reported that the racial and ethnic composition within the departments of pediatrics faculty are: 65% are non-Hispanic White, 18% Asian, and only 17% UIM [22, 23]. Beyond the efforts to explore pipeline issues to increase the number of diverse individuals considering a career in medicine, several others have explored issues of bias and equity for those

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✉ Eric Horowitz
horowite@ymail.com

[1] Department of Newborn Medicine, Boston Children's Hospital, Boston, MA, USA

[2] Institutional Centers for Clinical and Translational Research, Boston Children's Hospital, Boston, MA, USA

[3] Department of Pediatrics, University of Mississippi Medical Center, Jackson, MS, USA

identifying as UIM [8, 10, 24–29]. To better understand the current state of racial and ethnic equity among neonatologists, the largest subspecialty within pediatrics, we conducted a national survey of the current members of the American Academy of Pediatrics Section on Neonatal–Perinatal Medicine.

Methods

Instrument

This study expanded on previous work, and utilized a 70-item anonymous REDCap questionnaire that examined key variables in three main categories: employer factors, professional duties, and social factors [30]. Supplementary Table 1 lists these variable. This revised survey was pretested with a diverse convenience sample of 15 United States neonatologists to assess face validity. Their pretest responses were not included in the final data set. IRB exemption for this study was approved by the Boston Children's Hospital Institutional Review Board.

Study setting and participants

During the month of February 2018, this study utilized a national anonymous sample from the all members listserv of the AAP Section on Neonatal–Perinatal Medicine which reaches over 70% of the total US American Board of Pediatrics Neonatal–Perinatal Medicine Delegates. All participation was voluntary, and completion of the survey was demonstration of consent.

Main outcomes

Based on review of the literature, we focused our analysis on five main outcome areas: clinical time, leadership roles (Committee Chair or Division Chief, or Department Chair), total cash compensation in 2017 US dollars (pretax cash payments due to highly variable and nuanced federal and state tax implications and excluding the value of fringe benefits), scholarly productivity (number of publications and being a primary investigator in a NIH-funded grant), and achieving the academic rank of full professor.

Main predictors

Our main predictors are race and ethnicity. For the purposes of this study, respondents were placed into three racial and ethnic categories: non-Hispanic White, Asian, and UIM as defined by the United States Census Bureau and other organizations [17, 22].

Data analysis

Statistical analysis of the responses was completed with JMP 15.2.1 (a statistical software platform by SAS, Cary, NC, 2019). To assess the association between Asian and UIM identities with clinical hours worked annually and number of publications, linear ordinary least squares (OLS) regression models were used. To assess the association of race and ethnicity on leadership roles, grant funding, and academic rank, binomial variables for roles of Institutional Committee Chair, Division Chief or Group Leader, holding National Institutes of Health (NIH) funding, and rank of full professor were analyzed by logistic regression. Amount total annual cash compensation and grant funding showed skewed distributions and were natural log-transformed followed by a OLS regression model. In sensitivity analyses, several alternative models were developed, including generalized linear models with a log link and gamma distribution, these models produced very similar results to the OLS models on the logged outcome and are not presented. The incremental effects of the final model of monetary compensation are reported as percentage difference, calculated as $100\% \times (\exp(\text{regression coefficient}) - 1)$. To convert the percent estimates into dollar amounts, the percent estimates of the regression model were multiplied by the median total cash compensation value of $280,000 and median grant funding amount of $100,000.

Potential confounders considered in all models included: region of country, level of nursery, time spent in different professional duties, academic affiliation status, amount of scholarly activity, primary investigator status for different funding sources, time since completing fellowship training, race and ethnicity groupings, gender identity, and amount of cash compensation. Final variables used in the models are listed in corresponding tables, with selection based on statistical significance (at alpha = 0.05) of individual variables and force inclusion of variable supported by other studies.

Results

Overall, 560 responses were obtained from the active members of the AAP Section on Neonatal–Perinatal Medicine, a response rate of 15.7%. A total of 335 respondents, 250 non-Hispanic White (75%), 51 Asian (15%), and 34 UIM (10%), were analyzed after exclusion of 225 responders: not board certified/eligible or practicing in the United States (56), working part time or per diem (39), or lacked indication of race and ethnicity due to early termination of the survey (130).

Table 1 Race and ethnicity comparison of key clinical setting variables.

	Race and ethnicity				
	Non-Hispanic White ($n = 250$)	Asian ($n = 51$)	p value	Underrepresented in medicine ($n = 34$)	p value
Employer type					
Hospital or healthcare system	74%	80%	NS	56%	NS
Contracted: private single subspecialty group	13%	10%		29%	
Contracted: private multispecialty group	12%	10%		15%	
Military or Federal Government	1%	0%		0%	
Other	0%	0%		0%	
Academic or nonacademic affiliation					
Academic	71%	82%	NS	62%	NS
Non academic	29%	18%		38%	
Level of primary nursery for clinical duties					
Level 4 (Regional Neonatal Intensive Care Unit)	55%	63%	NS	38%	NS
Level 3 (Neonatal Intensive Care Unit)	42%	37%		62%	
Level 2 (Special Care Nursery)	3%	0%		0%	
Characteristics of primary nursery for clinical duties					
Number neonatologists rotating at primary nursery[a]	10 (6–17)	10 (7–16)	NS	7.5 (4–17)	NS
Capacity of primary nursery[a]	50 (32–68.5)	55 (35–65)	NS	36 (24.75–67)	NS
Delivery volume[a]	3000 (1337.5–4500)	3800 (2000–5000)	NS	2900 (1937.5–3500)	NS
Clinical duties[a]					
Clinical service—weeks/year	18 (12–26)	18 (12–26)	NS	17 (12–36)	NS
Weekday daytime clinical shifts per year	86 (60–120)	90 (60–120)	NS	90 (67.5–155)	NS
Weeknight clinical shifts per year	36 (18–60)	40 (30–60)	NS	48 (27–81.25)	0.016
Weekend daytime clinical shifts per year	24 (15–32)	20 (12–26)	NS	25 (17.25–37)	NS
Weekend night time clinical shifts per year	15 (10–24)	15 (10–24)	NS	20.5 (12–28)	NS
Clinical hours/year	1919.5 (1408.75–2623.5)	1898 (1584–2520)	NS	1957 (1506.75–3124)	NS
Average daily census[a]					
Total rounding census	20 (16–29)	20 (16–25)	NS	22 (16–32)	NS
Call type provided					
In-house	39%	47%	NS	29%	NS
From home	35%	27%		35%	
Both in-house and from home	23%	25%		35%	
No call	4%	0%		0%	
Region					
Great Lakes region—OH, MI, IN, IL, WI, MN	19%	24%	NS	18%	0.008
Mid-Atlantic region—WV, VA, DE, MD, DC, NC, PA, NJ	20%	12%		9%	
North Central region—IA, MO, KS, NE, SD, ND	9%	12%		3%	
Northeast region—ME, NH, VT, MA, CT, NY, RI	18%	20%		9%	
Northwest region—MT, WY, ID, OR, WA	6%	0%		3%	
South Central region—TX, OK, AR	5%	8%		21%	
Southeast region—SC, GA, FL, AL, MS, LA, TN, KY	12%	12%		29%	
Southwest region—AZ, UT, CO, NM, NV	3%	2%		6%	
West region—CA, AK, HI	7%	12%		3%	

[a]Median value (interquartile range).

Sample description

Institutional and practice characteristics and description of clinical duties

Table 1 describes institutional and practice characteristics across the three racial/ethnic groups. No significant differences were found for employer type, academic affiliation, level of nursery, capacity of primary NICU, or delivery volume. Neonatologists, however, who identified as an UIM were more likely to practice in the South Central or Southeast regions of the United states.

Beyond institutional and practice characteristics, Table 1 also describes the clinical duties across the three race/ethnicity groups. Overall, no differences were found between the three racial and ethnic groups for clinical

time, schedules, patient volume, team members, outpatient clinical duties, procedures, or moonlighting. Overall, neonatologists provided clinical service for ~90 weekdays, 40 weeknights, and 24 weekend shifts, or 1935 h, per year with 39% taking in-house call. Bivariate analysis between groups, Table 1, found that UIM neonatologists did provide more clinical coverage during weeknights (48 versus 36 for non-Hispanic-White, $p = 0.016$).

Leadership roles, compensation, and scholarly activity and achievement

As clinical care is often only part of the professional duties for a neonatologist, in Table 2 we describe leadership role achievement, compensation received, and scholarly activity. With regard to leadership achievement, no statistically significant differences were found among those groups for being a Committee Chair, Medical/Program Director, Division Chief, or Department Chair. When considering total cash compensation, however, a statistically significant unadjusted decrease of $40,000 in total cash compensation was noted for those identifying as Asian ($250,000 Asian versus $290,000 non-Hispanic White, $p = 0.005$), but no statistical difference was found for those identifying as underrepresented minorities ($277,500). In addition, no differences were found among the three groups when considering research time, grant receipt, or publications, or in attainment of the rank of full professor.

Social factors

Often factors outside of the professional environment can impact careers, and Table 3 describes social factors including gender, racial and ethnic distribution, location of graduate medical training, family composition, and retirement goals. Few differences were found. The main differences included those identifying as non-Hispanic White received international medical graduate training less often (5%) as compared to those who identified as Asian (59%, $p < 0.001$) or UIM, (47%, $p < 0.001$). This study did not investigate country of birth for any of the respondents.

Regression adjusted associations

To better understand how different factors may interact with each other and potentially impact the outcomes of interest, we constructed several multivariate models to assess the impact of racial and ethnic identity on clinical time, compensation, and scholarly achievement.

Association between racial and ethnic identity and clinical time

As no significant differences were noted in overall clinical duties, we conducted a multivariate analysis to control for potential confounding variables for amount of annual clinical time, Table 4. This model found that neither identifying as Asian nor UIM independently predicted the hours of clinical coverage provided by a neonatologist. Factors that did have statistically significant associations for an increased number of hours of clinical service time were working in the Southeastern region of the United States, primarily working in a Level 3 Nursery, and time allocated to medical education. Factors that were associated with less clinical time included the amount of time spent in administrative and research duties.

Association between racial and ethnic identity and leadership

Beyond the clinical duties of a neonatologist, we also attempted to control for confounding factors that may mask the influence of racial and ethnic identity on leadership roles and time spent in administrative duties. To explore leadership roles, we constructed multivariate models for holding the title of Institutional Committee Chair and the role of Division Chief or Group Leader, Table 4. In neither of these models were racial identity found to independently predict the attainment of either of these leadership roles.

Although we did not find a racial or ethnic difference in holding key leadership positions, we were also curious if there was a difference in the total time spent on administrative duties across all roles and involvement with committees. To assess this, we developed a regression model to control for factors influencing the time spent on administrative duties. This model did not find a statistically significant effect for Asian or UIM identities, Table 4. The factors that were independently associated with time spent annually on administrative duties were the amount of time spent in other activities, such as medical education, clinical duties, and research activities.

Association between racial and ethnic identity and compensation

To further explore factors contributing to the differences in total cash compensation, our multivariate model found a statistically significant decrease emerged for those identifying as UIM, but no difference was seen for those identifying as Asian, Table 4. This model suggested that being an UIM independently precited an average reduction in total annual cash compensation of $27 688 ($p = 0.042$). Other

Table 2 Race and ethnicity comparison of key leadership roles, compensation, and scholarly activity.

	Race and ethnicity				
	Non-Hispanic White ($n = 250$)	Asian ($n = 51$)	p value	Underrepresented in medicine ($n = 34$)	p value
Years post fellowship					
5 Years or less	17%	24%	NS	24%	NS
6–10 Years	19%	20%		9%	
11–15 Years	14%	22%		6%	
16–20 Years	6%	12%		15%	
21–25 Years	10%	10%		3%	
26–30 Years	16%	8%		21%	
31–35 Years	10%	4%		21%	
36 Years or more	9%	2%		3%	
Institutional administrative title(s)					
Committee Chair (Group/ Division/Department)	16%	27%	NS	15%	NS
Committee Chair (Institutional)	10%	10%	NS	12%	NS
Medical/Program Director	40%	43%	NS	35%	NS
Division Chief/Group President	16%	12%	NS	9%	NS
Department Chair	4%	2%	NS	6%	NS
Academic rank					
None	6%	0%	NS	5%	NS
Instructor	6%	10%	NS	0%	NS
Assistant Professor	36%	33%	NS	57%	NS
Associate Professor	27%	43%	0.038	14%	NS
Full Professor	26%	14%	NS	24%	NS
On a tenure track					
Yes	28%	24%	NS	29%	NS
Compensation[a]					
Base salary	$250,000 ($210,000–$300,000)	$240,000 ($205,750–$280,500)	NS	$245,158 ($215,000–$294,175)	NS
TOTAL cash compensation	$290,000 ($240,000–$360,000)	$250,000 ($222,000–$319,000)	0.005	$277,500 ($226,250–$352,500)	NS
Research					
Research—weeks/year[a]	0 (0–10)	2 (0–10)	NS	0 (0–10)	NS
Percent with grant funding	21%	25%	NS	24%	NS
Annual grant funding[a]	$87,000 ($11,250–$273,750)	$100,000 ($37,500–$162,500)	NS	$127,500 ($18,500–$700,000)	NS
Grant funding source(s)					
NIH funding	10%	14%	NS	21%	NS
Foundation funding	9%	10%	NS	12%	NS
Commercial funding	3%	6%	NS	9%	NS
Institutional funding	6%	8%	NS	12%	NS
Percent who submitted for grant funding	20%	31%	NS	15%	NS

Table 2 (continued)

	Race and ethnicity				
	Non-Hispanic White ($n = 250$)	Asian ($n = 51$)	p value	Underrepresented in medicine ($n = 34$)	p value
Grants applications this year[a]	2 (1–3)	2 (1–3)	NS	2 (1.5–4)	NS
NIH grant	12%	14%	NS	15%	NS
Foundation grant	10%	20%	NS	9%	NS
Commercial grant	2%	4%	NS	3%	NS
Institutional grant	9%	14%	NS	6%	NS
Academic productivity[a]					
Publications submited this past year	1 (0–3)	1 (0–3)	NS	1 (0–2)	NS
Total primary authored publications	3 (1–12)	4 (1–15)	NS	3 (1.75–5)	NS
Presentations in the past year	4 (2–6.5)	4 (2–6)	NS	4 (1–5)	NS

[a]Median value (interquartile range).

factors also associated with a reduction in compensation were being salaried, identifying as female, being academically affiliated, working in the Mid-Atlantic or Northeastern regions of the United States, and time dedicated to research. Factors found to predict an increase in total cash compensation were receiving a bonus and as expected, time since completing fellowship.

Association between racial and ethnic identity and scholarly accomplishment

As scholarly achievement is often measured in number of publications, attainment of NIH funding, and advancement to the rank of Full Professor, we wanted to explore these outcomes beyond simple bivariate analysis, and so created regression models for each of these outcomes.

Our model predicting the number of principally authored publications for a neonatologist failed to find an association with identifying as either Asian or UIM, Table 5. The factors that did predict increased numbers of publications were being a principal investigator for local or NIH grants, time since completing fellowship, and number of publications submitted. In opposition to these factors, being female or holding federal grants predicted fewer publications.

While bivariate analysis did not find a statistical difference for being a primary investigator for an NIH grant, Table 2, we felt the values of 10% for non-Hispanic White, 14% for Asian, and 21% for UIM needed further exploration. After correcting for several confounding variables shown in Table 5, our logistic regression model found that identifying as an UIM increased the odds of being a primary investigator for an NIH grant by 6.93 ($p = 0.011$). Other factors with increased odds for holding NIH funding were submitting a grant within the past year, having protected time for research, number of annual presentations, and number of primary authored publications. Asian identity did not reach statistical significance in this model.

With this finding regarding receipt of NIH grant funding, any source total grant funds were also examined by multivariate analysis. Racial and ethnic identity were not found to be associated with the amount of annual grant funding, Table 5. While the average for grant funding for UIM was almost $50,000 higher than for white, the average was likely skewed by a number of very large grants received by UIM, Table 2.

While publications and receipt of grants are the primary product of scholarly work, the ultimate recognition of these efforts is being awarded the rank of full professor. With race and ethnicity not found to independently predict publication productivity but finding that they predicted a higher odds of holding NIH funding, we explored factors associated with the rank of full professor. In this model, identifying as Asian or UIM, did not have a statistically significant impact on holding the rank of full professor, Table 5. The factors that increased the odds of achieving this academic rank were holding grant funding, time since the completion of fellowship, time spent in administrative duties, and number of publications.

Discussion

Addressing cultural diversity and equity has recently gained overdue heightened awareness with longstanding racial

Table 3 Race and ethnicity comparison of key social factors.

	Race and ethnicity				
	Non-Hispanic White ($n = 250$)	Asian ($n = 51$)	p value	Underrepresented in medicine ($n = 34$)	p value
Gender					
Male	55%	53%	NS	59%	NS
Female	45%	47%		41%	
Graduate medical training					
American	95%	41%	<0.001	53%	<0.001
International	5%	59%		47%	
Ethnicity and race					
American Indian or Alaska Native	0%	0%	NA	0%	NA
Asian	0%	100%		0%	
Non-Hispanic Black	0%	0%		35%	
Hispanic	0%	0%		65%	
Native Hawaiian or other Pacific Islander	0%	0%		0%	
Non-Hispanic White	100%	0%		0%	
Other	0%	0%		0%	
Declined	0%	0%		0%	
Current relationship status					
Married/significant relationship	92%	90%	NS	82%	NS
Widowed, divorced, or separated	4%	4%		3%	
Single/never married	4%	6%		15%	
Significant other employment status					
Full time	55%	62%	NS	50%	NS
Part time	12%	9%		14%	
Home/unemployed	33%	29%		36%	
Child status					
Have children	88%	82%	NS	79%	NS
Number of children (mean)[a]	2 ± 1	2 ± 1	NS	3 ± 2	NS
Desired age of retirement[a]	66 ± 6	67 ± 7	NS	66 ± 5	NS
Years until retirement					
5 years or less	17%	4%	NS	15%	NS
6–10 years	18%	22%		29%	
10–15 years	14%	16%		18%	
16–20 years	14%	18%		3%	
21–25 years	15%	18%		15%	
26–30 years	11%	6%		9%	
31–35 years	10%	14%		9%	
36 years or more	1%	4%		3%	
Would could same job again					
Yes	82%	73%	NS	85%	NS

[a]Mean ± standard deviation.

Table 4 Multivariate analysis of clinical, leadership, and compensation.

Target variable	Factors	Clinical time (hours/year)	*p* value
Clinical hours worked per year (R^2 adjusted: 0.26)	Region—Southeast (yes)	634 (322 to 947)	<0.001
	Primarily cover a Level 3 nursery (yes)	414 (73 to 756)	0.018
	Underrepresented in medicine (yes)	80 (−272 to 432)	NS
	Medical education (weeks/year)	30 (15 to 46)	<0.001
	Administration (weeks/year)	−22 (−32 to −13)	<0.001
	Research (weeks/year)	−31 (−40 to −22)	<0.001
	Asian (yes)	−45 (−197 to 107)	NS
Title of Institutional Committee Chair (AUC: 0.81)	**Factors**	**Odds ratio**	***p* value**
	Asian (yes)	1.51 (0.5–4.59)	NS
	Underrepresented in medicine (yes)	1.45 (0.41–5.13)	NS
	Years post fellowship (5-year blocks)	1.38 (1.13–1.7)	0.002
	Medical education (weeks/year)	1.06 (1.02–1.1)	0.003
	Number of annual presentations	1.05 (1–1.1)	0.039
	Research (weeks/year)	1 (0.96–1.05)	NS
	Number of primary authorships	0.99 (0.97–1)	NS
	Clinical time (weeks/year)	0.97 (0.93–1)	NS
	Gender (female)	0.35 (1.25–6.58)	0.013
Title of Chief/Group Leader (AUC: 0.84)	**Factors**	**Odds ratio**	***p* value**
	Publications (>10)	2.38 (1.1–5.15)	0.027
	Years post fellowship (5-year blocks)	1.43 (1.19–1.73)	<0.001
	Asian (yes)	0.88 (0.29–2.67)	NS
	Underrepresented in medicine (yes)	0.5 (0.13–1.91)	NS
	Clinical (>12 weeks/year)	0.4 (0.19–0.87)	0.02
	Gender (female)	0.34 (0.16–0.73)	0.006
	Research (>15 weeks/year)	0.23 (0.06–0.81)	0.023
Administrative hours worked per year (R^2 adjusted: 0.27)	**Factors**	**Odds ratio**	***p* value**
	Primarily cover level 4 nursery (yes)	119 (−24 to 263)	NS
	Asian (yes)	74 (−21 to 169)	NS
	Medical education (weeks/year)	45 (36 to 53)	<0.001
	Clinical time (weeks/year)	−13 (−18 to −7)	<0.001
	Research time (weeks/year)	−14 (−20 to −7)	<0.001
	Underrepresented in medicine (yes)	−55 (−280 to 170)	NS
Total cash compensation (R^2 adjusted: 0.36)	**Factors**	**Dollars per year**	***p* value**
	Salaried (yes)	−$63,475 (−$15,628 to −$111,323)	0.01
	Gender (female)	−$42,503 (−$25,843 to −$59,165)	<0.001
	Academic affiliation (yes)	−$37,686 (−$18,208 to −$57,165)	<0.001
	Region—Northeast	−$36,155 (−$14,271 to −$58,039)	0.001
	Region—Mid-Atlantic		0.002

Table 4 (continued)

Target variable	Factors	Clinical time (hours/year)	*p* value
		−$34,451 (−$13,003 to −$55,899)	
	Underrepresented in medicine (yes)	−$27,688 (−$991 to −$54,384)	0.042
	Asian (yes)	−$20,217 (−$43,198 to $2764)	NS
	Research (weeks/year)	−$912 (−$171 to −$1654)	0.016
	Years post fellowship (5-year blocks)	$10,553 ($6887 to $14,219)	<0.001
	Bonus (yes)	$26,620 ($9984 to $43,255)	0.002

discrimination in the United States, the activities of the Black Lives Matter Movement, and racial disparities associated with the SARS-CoV-2 (COVID-19) pandemic. It has been well documented that underrepresented minorities in the US have worse health outcomes and have decreased access to healthcare. The healthcare work force is not immune to these issues. In fact, for decades efforts have been implemented to try to improve the diversity of the healthcare work force [1, 17]. Importantly, several studies have shown improved outcomes for minority patients being cared for by UIM physicians [17, 31, 32]. While seeking improved alignment of the diversity of the healthcare work force to that of the population that we serve is essential, it has proven to be a difficult process. It is our hope that identifying and remedying areas of cultural inequity among physicians will foster new awareness of these issues and help to remove some of the barriers to those who may consider pursuing a career in medicine. It is also important to track not only an increase in underrepresented minorities entering the profession, but to make sure that those UIM achieve equity in leadership, compensation, and professional success.

These issues are not new to neonatology. In 2004, the National Institute of Child Health and Human Development and the American Academy of Pediatric Section on Neonatal–Perinatal Medicine convened a workshop to explore research work force issues in neonatology, with a specific focus on underrepresented minority groups [33]. Their recommendations, however, focused on solutions to encourage groups to enter neonatology and academic medicine, and not on issues of equity for those currently within the field. A few years later, articles by Dennery from an African-American perspective, and by Valcarcel et al. from an Hispanic perspective, were published [3, 4]. Beyond identifying actions to encourage underrepresented groups to enter the field of neonatology, they also spoke on the issue of retention. They highlighted the need for mentors, the issue of overcommitment of those underrepresented minorities to institutional committees, improving research funding, and equitable compensation to remedy the inequities due to race and ethnicity seen in neonatology and pediatrics. Our finding suggest that these issues still exist.

While several studies have demonstrated that there is gender inequity with regards to promotion and senior leadership, less is known about the relation between racial and ethnic identity and professional promotion and leadership within medicine [8, 24, 26, 34–37]. The literature on racial and ethnic equity, however, is evolving. In 2000, a study by Fang et al. that explored the Association of American Medical Colleges Faculty Rooster System found that even after adjusting for gender, tenure, degree, department, medical school type, and research awards, that UIM faculty were less likely to be promoted as compared to their non-Hispanic White peers [24]. A 2018 study by Kaplan et al. exploring the National Faculty Survey, however, found that while UIM faculty had similar career satisfaction, grant funding, leadership roles, and compensation, they also had fewer publications and were less likely to be promoted or retained within academic careers [26]. Our data suggests that among those who choose a career as a neonatologist, racial and ethnic equity has somewhat improved. We failed to find differences in leadership, scientific publication, academic rank, or an overcommitment to institutional committees in those groups that identify as Asian or UIM. In fact, we found that UIM neonatologists had a higher likelihood of receiving NIH funding than their peers. This finding needs further exploration, but may suggest that systemic efforts described by others may be having a positive effect for neonatologists who identify as UIM [3, 4, 6, 12, 17].

To help explain difference between our study and others, Nunez-Smith et al. found that there is significant inter-institutional variation in the promotion of racial and ethnic

Table 5 Multivariate analysis of scholarly achievements.

Target variable	Factors	Publications	*p* value
First or senior authorship(s) (R^2 adjusted: 0.36)	Primary investigator for local/ regional grant	11.6 (4.9 to 18.3)	<0.001
	Primary investigator for NIH Grant	10.6 (5.1 to 16.2)	<0.001
	Years post fellowship (5-year blocks)	3.6 (2.4 to 4.9)	<0.001
	Publications submitted	3.4 (2.3 to 4.4)	<0.001
	Primary investigator for foundation grant	2.4 (−2.9 to 7.8)	NS
	Research time (weeks/year)	0.1 (−0.2 to 0.4)	NS
	Non-Hispanic Asian (yes)	−0.3 (−7.9 to 7.2)	NS
	Primary investigator for institutional grant	−0.7 (−5.2 to 3.7)	NS
	Underrepresented in medicine (yes)	−1.7 (−8 to 4.6)	NS
	Female (yes)	−3.2 (−0.4 to −6)	0.025
	Primary investigator for commercial grant	−5.9 (2.4 to −14.2)	NS
	Primary investigator for state grant	−8.7 (0.1 to −17.5)	NS
	Primary investigator for federal grant	−17.9 (−5.6 to −30.1)	0.004
Primary investigator for NIH grant (AUC: 0.93)	**Factors**	**Odds ratio**	***p* value**
	Underrepresented in medicine (yes)	6.93 (1.56–30.72)	0.011
	Submitted a grant (yes)	6.82 (2.46–18.9)	<0.001
	Asian (yes)	2.59 (0.8–8.44)	NS
	Research (weeks per year)	1.11 (1.07–1.16)	<0.001
	Number of annual presentations	1.07 (1.01–1.13)	0.022
	Number of primary authorships	1.02 (1–1.04)	0.016
	Early career (yes)	0.18 (0.05–0.69)	0.012
Total annual grant funding (R^2 adjusted: 0.39)	**Factor**	**Funding**	***p* value**
	Academically affiliated (yes)	$232,062 ($75,027 to $389,098)	0.004
	Research time (>15 weeks/year)	$110,524 ($23,161 to $197,887)	0.014
	Primary investigator for commerical grant	$68,945 ($14,394 to $123,495)	0.014
	Asian (yes)	$62,843 (($51,151) to $176,838)	NS
	Primary investigator for NIH grant	$57,251 ($13,642 to $100,860)	0.011
	Primary investigator for foundation grant	$54,613 ($12,453 to $96,773)	0.012
	Underrepresented in medicine (yes)	$23,129 (($45,875) to $92,134)	NS
Rank of full professor (AUC: 0.94)	**Factors**	**Odds ratio**	***p* value**
	Grant funded (yes)	5.97 (1.66–21.48)	0.006
	Years post fellowship (5-year blocks)	2.46 (1.74–3.47)	<0.001
	Administration time (weeks/year)	1.06 (1.02–1.11)	0.006
	Number primary publications	1.06 (1.02–1.1)	0.002
	Research time (weeks/year)	0.97 (0.91–1.03)	NS
	Underrepresented in medicine (yes)	0.86 (0.2–3.72)	NS
	Non-Hispanic Asian (yes)	0.79 (0.16–3.91)	NS
	Female (yes)	0.55 (0.21–1.39)	NS

minority faculty [28]. They found that approximately one third of medical schools had equitable rates of promotion, but that a large proportion of medical schools had significant disparities in rates of promotion for Black and Hispanic faculty. One factor that seemed to predict some of these effects were that larger institutions tended to be less equitable, while small institutions achieved better promotion equity. Due to the small percentage of academic UIM in our study, our lack of finding a statistical difference should be validated with further research.

While several studies have shown that female physicians earn significantly less than their male peers, there is limited data exploring racial/ethnic equity in compensation for physicians [29, 38, 39]. Our work explored for this difference, and after correcting for several confounding variables, found that being an UIM was an independent factor in a decrease in total cash compensation, with a reduction of over $27,000 per year. Over a 30-year career, this difference could amount to a loss of gross earnings of over $800,000, and if these funds were placed into a conservative pretax investment account with an average rate of return of 6%, the value of this money could grow to over $2,000,000 by retirement. While findings by Palepu et al. failed to find a significant difference in adjusted mean compensation for UIM in their 1995 study of medical school faculty, more recent studies have brought this finding into question [29]. Consistent with our findings, Ly et al. in their 2016 article, analyzed two national data sets, the American Community Survey administered by the US Census and the Center for Studying Health System Change physician surveys, and determined that Black physicians earned between $27,000 and $37,000 less in adjusted annual income [39]. Further, examining racial differences in annual income of pediatricians, Weeks and Wallace found that Black female pediatricians earned $50,000 less than their White male peers [38]. The field of pediatrics must acknowledge and remedy this inequity.

Although beyond the primary focus of this paper, as many have proposed that the use of mentorship and financial incentives to increase recruitment of underrepresented minorities into medicine may improve UIM representation, perhaps seeking a better understanding of what has attracted diverse groups into medicine, at both the personal and systems levels, may give insights into new tools to aid such efforts and help to improve the diversity of medical providers.

The high representation of UIM in South Central or Southeast regions of the United States may be due to the higher numbers of underrepresented minorities living and completing their training in these areas. For UIM groups, further understanding into other reasons why physicians select their practice location may help identify factors that will attract these individuals to other regions and improve overall care for minority groups in the US. The South Central or Southeast regions of the US have higher percentages of minority groups, and tend to have high rates of poverty, infant and neonatal mortality, prematurity, and the underinsured [22, 40]. If having a physician with a similar race or ethnicity may improve outcomes for patients of minority groups, it will be critical to further investigate ways for neonatologists to practice in underserved areas, and still achieve professional success. Further acknowledging that UIM, in our study, seem to be less likely to have graduated from an American medical school, suggests that efforts to improve recruitment of UIM into medical school and neonatology is critical in order to replace those individuals likely to retire over the next 10 years. As highlighted in the papers by Dixon et al., Dennery, Valcarcel et al., and Flores et al. UIM leadership and mentorship as critical for recruiting and retaining UIM in pediatrics, the loss of senior UIM in neonatology to retirement will potentially hurt future recruitment, promotion, and retention efforts [3, 4, 10, 12].

With regards to Asian identity and medicine, their experience is different than that of UIM, but still fraught with concern. While one might argue that those that identify as Asian are overrepresented in medicine, Ko and Ton eloquently discuss the role that Asian physicians play in promoting a diverse medical work force, as well as, the current potential legal challenges that may restrict Asian admissions into medical school and constrict this potential pool of future physicians [14]. Recent federal policies impacting and limiting immigration, especially of professionals in the field of medicine will greatly affect our future work force in pediatrics and neonatology. As with all efforts for improvement, one needs to balance the intended goals of policy and actions with the potential unintended consequences of the balancing measures.

To help best find ways to encourage that next generation to follow the path to neonatology, maybe we can learn from the efforts of some more recent programs. The Northwest Native American Center of Excellence efforts with the Tribal Health Scholars, the Wy'East Post-baccalaureate Pathway, and Indigenous Faculty Forum have helped increase the number of those identifying as American Indian/Alaska Native considering careers in medicine [13]. The New Century Scholars program, through its use of mentorship, has successfully helped UIM pediatric residents find their way into academic pediatric medicine [5].

This study increases our understanding of where racial and ethnic differences and inequities exist, as well as what factors may motivate individuals to select and continue with their careers, and in doing so it helps identify ways to attract future neonatologists into this profession, and to provide them with the resources and motivations to successfully and equitably continue in their career.

Limitations of this study include the response rate of 15.7%, although similar to other survey studies of compensation and of physician providers [41]. As the American Board of Pediatrics has only recently begun collecting racial and ethnic identity data, we cannot assess how representative the diversity of our sample is to the general population of practicing neonatologists. This is further complicated by the fact that these racial and ethnic categories may lump many different cultures, heritages, ancestries, and origins within them and not best describe the diversity within each category. Methodological limitations also include that these data were collected by anonymous self-report which does not allow for validation of data or clarification of information provided, and therefore can lead to recall and self-selection bias. Nevertheless, we developed these measures utilizing standard survey design techniques to produce questions with strong face validity that were refined through convenient sampling validation and compared to the data obtained from prior surveys. Lastly, this is an observational study, and therefore finds associations rather than causation, which is subject to confounding from unobserved factors.

This study also has several strengths which include a study design allowing for inclusive national participation from a single medical specialty with broad representation of different career paths and practice types, and anonymity of responses that fostered increased granularity of collected data. Further, this granularity of data allowed for construction of multivariate models to adjust for potential confounders and optimize assessment of potential associations.

Conclusion

Issues of diversity and equity have been gaining public awareness across many aspects of society and the work force. Understanding how to best attract a diverse pediatric work force is critical for the future of medicine. To aid these efforts, this is the first comprehensive study of full-time neonatologists in the United States to explore equity among racial and ethnic groups with regards to the key career factors of institutional environment, clinical duties, scholarly activity, leadership roles, and compensation. Its failure to find differences in aspects of clinical and scholarly time, scholarly productivity, and leadership attainment give hope that a career in neonatology can be very rewarding for all who pursue it. Differences in compensation and attainment of grant funding, however, suggest more work needs to be done, and further underscore the need for additional action to reduce bias, champion equity, inform policy, and promote advocacy. Only then will careers in neonatology be best positioned to attract the best, brightest, and diverse in our society to give the best care to those most fragile, newborn infants.

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Author contributions EH conceptualized and designed the study, designed the data collection instrument, collected data, carried out initial analysis, drafted the initial paper, and reviewed and revised the paper. MS reviewed the data collection tool, critically reviewed statistical analysis, and critically reviewed the paper for important intellectual content. RS reviewed the data collection tool, and critically reviewed and revised the paper. All authors approved the final paper as submitted and agree to be accountable for all aspects of the work.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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