Published in final edited form as:

Ophthalmology. 2013 October ; 120(10): 2146–2150. doi:10.1016/j.ophtha.2013.02.021.

Characterization of a Clinician-Scientist Cohort in Ophthalmology: A Demographic Analysis of K Grant Awardees in Ophthalmology

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Abstract

Objective—To analyze ophthalmologists who are National Institutes of Health (NIH) K grant awardees to characterize clinician-scientists in ophthalmology.

Design—Cohort study.

Participants—Ophthalmologists who have received a K award from 1996 to 2010.

Methods—K08 and K23 grant awardees were identified through the NIH Research Portfolio Online Reporter database. Information including gender, institution, educational degrees, and success in obtaining an R01 grant was analyzed.

Main Outcome Measure—Receipt of an R01 grant.

Results—One hundred five ophthalmologists were identified who received K08 or K23 grants from the National Eye Institute from 1996 to 2010. Overall, 75% of these were male, although 43% of K awardees were women from 2006 to 2010. Sixty five percent (68/105) of individuals came from ophthalmology departments that ranked in the top 20 of NIH funding in 2010. The most predominant subspecialties represented were retina (32%), cornea (22%), and glaucoma (15%). Among the K awardees, 40% (42/105) had a Doctor of Philosophy (PhD) degree in addition to their Medical Doctor (MD) degree. From 1996 to 2000, 61% (23/38) individuals were successful in obtaining an R01 grant, while only 13% (5/39) individuals from 2001 to 2005 have obtained R01 grants ($p < 0.001$).

Conclusions—Gender disparities exist among K awardees in ophthalmology, but these seem to be improving over time. None of the other variables studied: gender, PhD degree, specialty, or funding tier was associated with obtaining R01 funding. This study helps to characterize the clinician-scientist cohort in ophthalmology and identify areas to improve the recruitment of these individuals.

INTRODUCTION

Clinician-scientists have long been recognized to play a vital and unique role in academic medicine.^{1,2} These individuals, who have significant clinical as well as research training,

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Conflicts of Interests: The authors have no relevant financial interests in this work.

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possess a unique perspective and skill set that allows them to participate at multiple levels along the “bench to bedside” translation of basic discoveries to new clinical therapies. This is no less true in ophthalmology, where clinician scientists have made important contributions to advancing knowledge and treatment of ocular disease. Although most ophthalmologists agree on the value of these individuals, this cadre of individuals has been increasingly considered an “endangered species” as the viability of the clinician-scientist in ophthalmology has been continually called into question.^{3–5} Multiple reasons have been suggested for the shortage of these individuals including the protracted training course, the scarcity of grant funding, lack of departmental support and protected research time, and the economic disincentives for pursuing a clinician-scientist track versus private practice.^{2,3,5,6}

Although there have been several editorials about clinician-scientists in ophthalmology,^{3–5} a review of the published literature indicates an absence of a systematic analysis of such individuals. Such information may be helpful in assessing the current state of clinician-scientists in ophthalmology, and may suggest areas of focus to sustain the supply of clinician-scientists in ophthalmology. A particularly informative group to investigate is ophthalmologists who have received K grant awards from the National Institutes of Health (NIH). K awards (i.e., the K08, K12, and K23 grants) are early career development awards for individuals who have finished their clinical training and are committed to significant additional research training in order to pursue independent careers as clinician-scientists (<http://grants.nih.gov/training/careerdevelopmentawards.html>, last accessed December 5, 2012).

These individuals receive financial support for protected research time for a period up to 5 years to develop an independent research career in either laboratory or clinically based research. K08 grants are focused on laboratory research, while K23 grants are more oriented toward clinical research. In addition, the K12 award is a third type of K award given to select institutions deemed to be ideal environments to cultivate clinician-scientists. Current eye institutions with National Eye Institute (NEI) K12 awards are Johns Hopkins University/Wilmer Eye Institute, Harvard Medical School/Massachusetts Eye and Ear Infirmary, Washington University, Duke University, University of Pennsylvania/Scheie Eye Institute, University of Illinois at Chicago, University of California Berkeley School of Optometry, and the Ohio State University School of Optometry. The K12 grant functions like the K08/K23 awards, except this grant is awarded by the institution instead of the NEI. Individuals who receive K awards are highly talented and motivated to become clinician-scientists in ophthalmology. The purpose of this study is to systematically analyze the demographic characteristics of ophthalmology K grant awardees in order to provide a better understanding of this clinician-scientist cohort.

METHODS

A pubmed search (<http://www.ncbi.nlm.nih.gov/pubmed>, last accessed December 5, 2012) using the terms “ophthalmology” and “clinician scientist” was undertaken to identify previous literature relating to clinician-scientists in ophthalmology. K awardees were identified using the National Institute of Health’s online Research Portfolio Online Reporter Tools database (RePORTER) (<http://projectreporter.nih.gov/reporter.cfm>, last accessed May 20, 2011). Search terms used were K08 and K23 award recipients from the National Eye Institute from 1996 to 2010. Data including the recipient’s name, year beginning the K award, training institution, and project title were exported into a Microsoft Excel (Seattle, Washington) spreadsheet. These individuals were then individually searched in the RePORTER database to identify whether they received R01 grants.

Gender was determined by two independent reviewers who were asked to categorize these individuals as male or female. For those who were ambiguously characterized, gender was identified through Internet searches of the name looking for sex specific pronouns on institutional websites, scientific publications, or scholarly organizations. Educational degrees were determined for the recipient using university web pages and scientific publications, which listed educational degrees. The Association of Research in Vision and Ophthalmology (ARVO) directory was used to confirm degrees, whenever possible. Each project was categorized under a clinical specialty based on the title of the proposal. Areas of overlap were categorized under the recipient's clinical specialty.

Descriptive statistics for the K08 and K23 awardees are presented. Comparisons between K awardees who did and did not receive R01 grants were performed with the chi-square test for categorical variables. Independent predictive factors for success in obtaining an R01 grant were assessed for statistical significance with logistic regression. Statistical analysis was performed using IBM SPSS PASW Statistics Version 17.0. A p-value 0.05 or less was considered statistically significant.

K12 awardees were identified by emailing K12 directors at each of the respective programs with NEI K12 awards. A list of K12 awardees was provided by 4 out of the 8 programs, which included the recipient's name, gender, educational degrees, and award date. The University of Illinois at Chicago was given its K12 award in 2011, and thus fell outside of the study time frame. These names were then cross-referenced with the K08 and K23 awardees and searched in the NIH RePORTER database to determine if they had received R01 funding.

RESULTS

The RePORTER database identified 156 recipients of either K08 or K23 awards from the NEI between 1996 and 2010. Fifty-one recipients were found to be non-ophthalmologists (i.e. optometrists, veterinary ophthalmologists, or other medical specialties such as neurologists) and excluded from analysis, leaving 105 ophthalmologists who received K awards during the study time frame. K award recipients were then grouped into 5-year subsets (i.e. 1996–2000, 2001–2005, and 2006–2010) for analysis. Thirty-eight were awarded from 1996 to 2000, 39 from 2001 to 2005, and 28 from 2006 to 2010 (Table 1).

Significantly more males compared to females received K award from 1996 to 2005; males comprised 82% (63/77) of awardees ($p < 0.001$, chi-square test) (Table 1). Males comprised 79% (30/38) of awardees from 1996 to 2000 ($p < 0.001$, chi-square test) and 85% (33/39) from 2001 to 2005 ($p < 0.001$, chi-square test). However, 57% (16/28) were male from 2006 to 2010, which was not statistically significantly different from number of females during this time period ($p = 0.57$).

Each institution was categorized into one of 4 funding tiers based on NIH funding of the ophthalmology department in 2010 (Blue Ridge Institute for Medical research, NIH reporter database, http://www.brimr.org/NIH_Awards/2010/NIH_Awards_2010.htm, accessed May 20, 2011). The majority of individuals, 65% (68/105), came from one of the top 2 tiers of funding (Table 1). Specific institutions that trained 5 or greater K awardees during the study period include Johns Hopkins University (17), University of Pennsylvania (7), University of California San Francisco (6), Washington University (6), Duke University (6), University of Michigan Ann Arbor (5), and University of California- Los Angeles (5).

The distribution of K awardees' research areas is shown in Table 1. The majority of projects were in the subspecialty areas of retina (32%), cornea (22%), and glaucoma (15%). Other

subspecialties with K awardees were pediatric ophthalmology (10%), neuro-ophthalmology (7%), uveitis (6%), and oculoplastics (5%).

To determine whether additional research training predisposed individuals for a career as a clinician scientist, we evaluated whether having a Doctor of Philosophy (PhD) degree was enriched in this population. Overall, 40% (42/105) K awardees had obtained a PhD degree in addition to a Medical Doctor (MD) degree during their training (Table 1). However, the percentage of MD/PhDs as K awardees appears to be decreasing slightly, as they represented 50% (19/38) from 1996 to 2000, 36% (14/39) from 2001 to 2005, and 32% (9/28) of K awardees from 2006 to 2010 ($p = 0.13$, chi-square, linear-by-linear association).

We investigated how successful K awardees were in obtaining R01 funding by examining the NIH RePORTER database (Table 1). Sixty-one percent (23/38) K awardees from 1996 to 2001 were successful in obtaining an R01 grant, while only 13% (5/39) K awardees from 2001 to 2005 have obtained R01 grants ($p < 0.001$, chi-square test). From 2006 to 2010, one individual thus far has obtained an R01 grant. We also explored the association between conversion of K awards to R01 grants and gender, type of degree, specialty area of research, and institutional funding tier (Table 2). None of these factors significantly predicted which K awardees would be successful in receiving an R01 grant.

Analysis of K12 awardees was done separately, as this is a relatively recent program (first grant recipients in 2003). Twenty-one individuals received K12 awards at the 4 institutions which provided data from 2003 to 2010 (H. Quigley, R. Dana, G. Klintworth, M. Kass, personal communications). Twelve of 21 (57%) individuals who received a K12 award also received an individual K08 or K23 award, and thus were included in our analysis already reported. Among the remaining 9 individuals, 22% (2/9) had both MD and PhD degrees, 78% (7/9) were female, and 22% (2 out of 9) had been awarded R01 funding.

DISCUSSION

This study represents the first attempt to characterize clinician-scientists in ophthalmology. A number of interesting observations can be made from the data. First is the sheer dearth of individuals pursuing a clinician-scientist track with a decline over time (38 from 1996 to 2000, 39 from 2001 to 2005, and 28 from 2006 to 2010. With 458 ophthalmology residency spots offered in 2010⁷ and an average of 5 to 8 K awards given out to ophthalmologists each year, this suggests that less than 2% of ophthalmologists will receive a K award annually. About 10 applications for K awards are made to the NEI per year, and about 60% of K08 grants were funded from 2000 to 2009 (L. McNicol, personal communication). Thus, only 4 K applications are unfunded on average each year which suggests that the paucity of K award applications may be due to a lack of interest in this career pathway rather than a large number of applications being unfunded. Another explanation is that the recent development of institutional K-12 programs partly accounts for the low or seemingly decreasing application rate of ophthalmologists for individual K-awards. However, 57% of K12 awardees also received an individual K award, suggesting it may be a minority of K12 awardees who do not pursue an individual K award.

This shortage of clinician-scientists is not specific to ophthalmology; it is present across all medical disciplines, particularly in surgical subspecialties.^{6,8,9} Continued research should be performed to identify factors that motivate or deter physicians from pursuing the clinician-scientist track in ophthalmology and identify methods to encourage motivated individuals to pursue this career pathway.

Additionally, a large gender disparity was found among K awardees, as 75% overall were male. However, this distribution has been equalizing in recent years with 43% of females

being K awardees from 2006 to 2010. As a point of comparison, 38% of all K awardees from 1997 to 2003 across all NIH institutes were female; however in surgical fields, women represented only 14.8%.¹⁰ Thus, ophthalmology is similar to other fields of academic medicine, and perhaps better than average compared to other surgical specialties regarding female representation in the clinician-scientist track. This increase in female K awardees may be due to the increased number of female ophthalmology residents in recent years, more women being interested in pursuing research careers, or an increased presence of female faculty mentors to serve as role models. However, gender was not a factor in obtaining an R01 grant among K awardees.

To investigate whether clinician-scientists were enriched in certain subspecialties, each K awardee was categorized based on their clinical subspecialty and research project. The specialties with the largest amount of K awardees were retina (32%), cornea (22%), and glaucoma (15%). Oculoplastics, neuro-ophthalmology, and uveitis were subspecialties having less than 10% of K awardees. Subspecialty societies should give consideration to encouraging and recruiting motivated and talented individuals in pursuing this track.

Interestingly, while 65% of individual K awardees came from institutions ranked in the top two tiers of NIH funding, 35% of individuals received K awardees were not from these top two tiers. In addition, our analysis suggests that NIH funding tier was not significantly associated with the receipt of an R01 award. This suggests that amount of NIH funding in an ophthalmology department may not be the best predictor for success in clinician-scientist training. It may be that the individual recipient's mentor, and his or her track record of training clinician-scientists that may be of greater importance.

Ophthalmologists who have pursued significant research training and obtain a PhD degree in addition to the MD degree would be ideally suited to pursue the clinician-scientist track. Indeed, previous studies have suggested that significant research experience prior to residency is a significant predictor of future success in obtaining R01 grants.^{11, 12} In our study cohort, 40% of all individual K awardees had combined MD and PhDs degrees. As a point of comparison, less than 5% of applicants for ophthalmology residency at the Bascom Palmer Eye Institute in 2011 had MD and PhD degrees (K. Corser, personal communication) and 6.7% of residency applicants to Johns Hopkins University/Wilmer Eye Institute had a MD and PhD (N. Miller, personal communication). This suggests these individuals who have already had extensive research training before residency are over represented among individual K awardees. However, having a PhD was not a significant factor in predicting R01 success rates in our study, in contrast to studies in other medical specialties.¹² This could be due to the relatively small sample size of this study cohort compared to these studies, or represent a true difference between MD/PhDs in ophthalmology versus those in other medical specialties.

Receiving an NIH R01 grant is one of many metrics indicating the sustainability of an independent research career. The percentage of ophthalmology K awardees receiving R01 awards has dropped precipitously since 1996, with 61% of individuals receiving an R01 grant from 1996 to 2000 and only 13% from 2001 to 2005. One caveat is that we may be underestimating the percent of individuals who will receive a R01 grant as sometimes there can be substantial delay until successful R01 funding. In our cohort, the mean time from end of K award to onset of R01 funding was 1.1 years (range -3 years to 11 years, n=29). Eighty-six percent (25/29) of R01 awardees in our cohort received their R01 within 3 years upon completion of the K award. Therefore we have likely accounted for the vast majority of R01 awardees, but may be slightly underestimating R01 success rates. This R01 success rate is consistent with overall trends with K awardees in other medical specialties.¹⁰ Over the past 10 years, the success rate for an R01 application to the NIH has decreased dramatically,

from around 30% in 1998 to an all time low of 18% in 2011. (<http://report.nih.gov/NIHDataBook/Charts/Default.aspx?showm=Y&chartId=124&catId=13>, accessed December 5, 2012). This decrease in success rate is likely due to both stagnant grant funding available from the NIH as well as the increased number of investigators applying for funding. Future research should be performed to identify specific factors which may predict success in obtaining R01 grants among ophthalmologists, and thus identify factors which may lead to the sustainability of clinician-scientists in ophthalmology in this very competitive environment.

There are multiple caveats and limitations to this study. This study only analyzed individuals who received K08 and K23 grant awards from the National Eye Institute from 1996 to 2010. Ophthalmologists who were clinician-scientists before 1996 were not included. Clinician-scientists in ophthalmology who did not receive K awards also were excluded from this analysis. This would include individuals who directly received an R01 grant, received a K award from another NIH institute, or those who are funded through private philanthropic organization or other governmental agencies.

This study provides the first systematic survey of a clinician-scientist cohort in ophthalmology. The data presented here demonstrates the scarcity of such individuals in ophthalmology. Additional studies are needed to identify strategies to replenish and sustain the pipeline of clinician scientists in ophthalmology in the future.

Acknowledgments

Supported by NIH Center Core Grant P30EY014801, Research to Prevent Blindness Unrestricted Grant, and Department of Defense (DOD- Grant W81XWH-09-1-0675).

We thank Drs. Harry Quigley, Reza Dana, Gordon Klintworth, and Michael Kass for providing information on K12 awardees in their respective programs. We thank Dr. Neil Miller and Kathy Corser for providing information on the number of MD/PhD applicants to their respective residency programs. We thank Dr. Lorie-Ann McNicol for providing information on K award applications to the NEI. We thank Dr. Jeffrey Goldberg for critical reading of the manuscript.

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Table 1

Demographic Characteristics of Ophthalmology K Awardees

	Total (n = 105)	1996–2000 (n = 38)	2001–2005 (n = 39)	2006–2010 (n = 28)
Gender				
Female	26 (25%)	8(21%)	6 (15%)	12(43%)
Male	79 (75%)	30(79%)	33(85%)	16 (57%)
Degree				
MD/PhD	42 (40%)	19 (50%)	14 (36%)	9 (32%)
MD	63 (60%)	19 (50%)	25 (64%)	19 (68%)
Specialty				
Cornea	23 (22%)	6 (16%)	9 (23%)	8 (29%)
General	4 (4%)	2(5%)	1(3%)	1 (4%)
Glaucoma	16 (15%)	6 (16%)	4 (10%)	6 (21%)
Neuro-ophthalmology	7 (7%)	4 (11%)	3 (8%)	0 (0%)
Oculoplastics	5 (5%)	1 (3%)	3 (8%)	1 (4%)
Pediatric ophthalmology	10 (10%)	5 (13%)	4 (10%)	1 (4%)
Retina	34 (32%)	10 (26%)	13 (33%)	11 (39%)
Uveitis	6 (6%)	4 (11%)	2 (5%)	0 (0%)
Tier ^I				
1	50 (48%)	19 (50%)	20 (51%)	11 (39%)
2	18 (17%)	7 (18%)	4 (10%)	7 (25%)
3	18 (17%)	5 (13%)	8 (21%)	5 (18%)
4	19 (18%)	7 (18%)	7 (18%)	5 (18%)
Obtained R01 Grant				
Yes	29 (28%)	23 (61%)	5 (13%)	1 (4%)
No	76 (72%)	15 (39%)	34 (87%)	27 (96%)

^ITier 1 = institutions ranked 1–10; tier 2 = institutions ranked 11–20; tier 3 = institutions ranked 21–40; tier 4 = institutions ranked > 40

MD = Medical Doctor; PhD = Doctor of Philosophy

Table 2

Factors Associated with Conversion of K Awards to R01 Grants

	Received R01 Grant (n = 29)	Did Not Receive R01 Grant (n = 76)	P-value	
			Univariate ³	Multivariate ⁴
Gender				
Female	5 (19%)	21 (81%)	0.4	0.3 (0.7)
Male	24 (30%)	55 (70%)		
Degree				
MD/PhD	13 (31%)	29 (69%)	0.7	0.5 (0.5)
MD	16 (25%)	47 (75%)		
Specialty				
Cornea	5 (22%)	18 (78%)	0.6	0.6 (0.9)
General	1 (25%)	3 (75%)		
Glaucoma	5 (31%)	11 (69%)		
Neuro-ophthalmology	4 (57%)	3(43%)		
Oculoplastics	1 (20%)	4 (80%)		
Pediatrics	2 (20%)	8 (80%)		
Retina	8 (24%)	26(76%)		
Uveitis	3 (50%)	3 (50%)		
Funding tier ¹				
1	15 (30%)	35 (70%)	0.9	0.9 (0.9)
2	5 (28%)	13 (72%)		
3	4 (22%)	14 (78%)		
4	5 (26%)	14 (74%)		
Year of K award ²				
1996–2000	23 (61%)	15 (39%)	< 0.001	< 0.001
2001–2005	5 (13%)	34 (87%)		

¹Tier 1 = institutions ranked 1–10 in 2010; tier 2 = institutions ranked 11–20; tier 3 = institutions ranked 21–40; tier 4 = institutions ranked > 40²Years 2006 to 2010 not included since K awardees are still on the training grant³Chi-square⁴Logistic regression with first 4 factors in the model

P-values in parentheses include year of K-award as a factor, with years 2006–2010 omitted.

MD = Medical Doctor; PhD = Doctor of Philosophy