Is Industry Funding Associated with Greater Scholarly Impact Among Academic Neurosurgeons?

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■ OBJECTIVE: **To determine the relationship between industry payments and scholarly impact among academic neurosurgeons.**

■ METHODS: **Faculty names and academic rank data were obtained from department websites, bibliometric data were obtained from the Scopus database, and industry payment data were obtained from the Center for Medicare and Medicaid Services open payments database (openpayments.cms.gov). The h-index was used to estimate scholarly impact. Payments were classified as "general," "associated research," and "research payments." Subgroup analyses were done for academic rank, fellowship training, and sex.**

■ RESULTS: **Among 1008 academic neurosurgeons, scholarly impact was greater among individuals receiving associated research industry support compared with those not receiving it. Scholarly impact also was greater among individuals who received more than $10,000 of any type of industry support compared with individuals who received less than that or no payment. This association also was seen in fellowship-trained surgeons. Female neurosurgeons were less likely than male neurosurgeons to get industry funding and were likely to get less funding.**

■ CONCLUSIONS: **There is a strong association between associated research funding from industry and scholarly impact among academic neurosurgeons. It's unclear whether this association is a result of funding facilitating more research projects that eventually lead to more high-impact publications, if industry is providing more funding to academic neurosurgeons with greater scholarly impact, or whether it represents intrinsic academic activity among a group of neurosurgeons who are more likely to be academically productive and procure funding from all potential sources to increase this activity.**

INTRODUCTION

Physicians have faced increasing scrutiny for financial ties to pharmaceutical companies and medical device manufacturers.[1] Consequently, in an effort to bring transparency to the financial relationships between physicians and industry, the Physician Payments Sunshine Act was enacted in 2010 along with the Affordable Care Act.[2] The act requires industry to track all financial relationships with physicians and to report them to the Center for Medicare and Medicaid Services (CMS). This information is then made publicly available on the open payments database website of the CMS. There has been great interest in these data from the public and physicians alike.[2] Several recent studies have analyzed the financial ties between physicians and industry, asking the important questions such as "Who is receiving how much for what purpose, and what does this mean?"[1,3-6]

Several studies in surgical specialties including neurosurgery have demonstrated a strong correlation between grants from various funding sources and scholarly impact.[7-11] In the past, the impact of funding from industry was difficult to study because of the private nature of this information. However, since the CMS open payments database website classifies industry payments by

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- Scholarly impact
- Sex disparity

Abbreviations and Acronyms
CMS: Center for Medicare and Medicaid Services

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the type of payment and research funding, we are now privy to this information.

To the best of our knowledge, no study has examined the relationship between scholarly impact and industry funding in neurosurgery. In this study, we explore whether there is an association between industry funding and scholarly impact among academic neurosurgeons. We also determine the roles of sex, academic rank, and fellowship training.

MATERIALS AND METHODS

A list of residencies was obtained from the American Association of Neurological Surgeons website (aans.org). Foreign, military, and governmental programs were excluded. Programs not directly affiliated with academic institutions, and programs whose websites provided very limited data also were excluded. From this, the faculty lists of 100 neurosurgery departments were evaluated on their department web pages. Information collected and used in this analysis included sex, academic rank, and fellowship training. Academic ranks considered were assistant professor, associate professor, and professor. Fellowships were organized into pediatrics, spine, vascular (including endovascular and cerebrovascular), neurosurgical oncology, stereotactic and functional surgery, multiple fellowships (including single fellowships that covered multiple categories, such as cerebrovascular and skull base), no fellowship, and other fellowships, a variation of fellowship classification by Agarwal et al.[12] However, 105 individuals' fellowship information could not be found online so they were excluded from the fellowship analysis only.

Publication and impact data were obtained from the Scopus database (www.scopus.com; Elsevier, Amsterdam, Netherlands). Impact was measured by the h-index, which is a measure of scholarly impact that accounts for number of citations, number of publications, and the distribution of those citations among those publications. For example, an h-index of 20 means that the author has produced 20 articles that have been cited at least 20 times.[13] The use of the h-index as a measure of scholarly impact in neurosurgery is well established.[12,14-20]

Number of publications and years of publication experience also were obtained. Three individuals' profiles appeared to be 2 different physicians merged profiles, deduced from publications in non–neurosurgery-related journals in years before the neurosurgeon would have started medical school and were excluded.

Industry payment data for 2015 were obtained from the CMS open payments website (openpayments.cms.gov). The database classified payments as general payments, research payments, or associated research funding. General payments are defined as "payments that are not associated with a research study"; research payments are defined as "payments that are associated with a research study"; and associated research funding is defined as "funding for a research project or study where the physician is named as a principal investigator." Total industry payments were calculated as the sum of all 3 of these.

Statistical Analysis

For comparison of continuous variables, 2-sided unpaired *t*-tests and analysis of variance were used. For comparison of categorical variables, χ^2 tests were used. An α level of 0.05 was selected in all cases. Microsoft Excel (Microsoft, Redmond, Washington, USA) was used for these calculations.

RESULTS

A total of 1008 academic neurosurgeons were included in this analysis. Overall, 75.5% of individuals had received some form of industry support in 2015, and 77.0% of those recipients received more than $10,000 of industry support (Figure 1A). There was no significant increase in h-index associated with receiving any industry support versus not receiving any support ($P > 0.05$; Figure 1B). There was, however, an increase in h-index among individuals who received greater than $10,000 compared with individuals who received less than that (including no payment) (mean h-index = 21.7 vs. 16.8 respectively, $P < 0.0001$) (Figure 1C).

Analysis by type of funding revealed that only receiving associated research funding was associated with an increase in h-index (23.5 vs. 17.7 respectively, $P < 0.0001$), whereas receiving general and research payments was not ($P > 0.05$ for both types of funding) (Figure 2A). The majority (74.4%) of neurosurgeons received general payments, and more individuals received associated research funding (9.0%) than research payments (2.3%) (Figure 2B). Individuals who received associated research funding from industry had greater average payments than those who received other types of funding (Table 1).

We then performed subgroup analyses to determine the continuity of the fact that industry payments greater than $10,000 were associated with a greater scholarly impact. This trend was not observed within any of the 3 academic ranks (assistant, associate, or full professor) ($P > 0.05$) (Figure 3). Industry payments increased with academic rank among those who received payment (Table 2). Subgroup analysis by fellowship training status revealed that this trend also was seen in fellowship-trained neurosurgeons but not in those with no fellowship training ($P < 0.05$). When broken down by fellowship types, the trend was seen in spine fellowship-trained neurosurgeons ($P < 0.05$) but not for the remaining fellowships ($P > 0.05$ in all other cases; Figure 4). Spine fellowship-trained neurosurgeons had one of the greatest proportions of individuals receiving funding more than $10,000 (33.3%) and one of the highest average industry payments among those who received industry support (Table 3). However, vascular-trained neurosurgeons had the highest h-index in those getting more than 10,000, despite spine surgeons getting the most research funding (Figure 4).

Subgroup analysis by sex revealed that men were 2.41 times as likely as women to receive industry funding (odds ratio = 2.41, 95% confidence interval = 1.54–3.78) (Figure 5A and B). Female academic neurosurgeons had decreased scholarly impact overall compared with male academic neurosurgeons (mean h-index = 11.1 vs. 18.9 respectively, $P < 0.001$). Among those who received payment, 23.0% of men received more than $10,000 of funding as opposed to 11.5% of women, but this difference was not statistically significant (odds ratio = 2.28, 95% confidence interval = 0.96–5.45) (Figure 5A and B). However, among those receiving funding, the average funding received was greater for men ($28,060 vs. $7465, $P < 0.001$; Table 4). Subgroup analysis for sex also revealed that the mean h-index was greater among