

Alpha Omega Alpha Election and Medical School Thesis Publication: Relationship to Subsequent Publication Rate Over a Twenty-Year Period

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To determine the importance of academic and research success during medical school upon subsequent academic activity, a computerized literature search was performed using the names of the 79 surviving members of the Yale Medical School Class of 1970. Individuals elected to Alpha Omega Alpha (AOA) during the third year of school had significantly more publications (mean 101.7 ± 69.6) between 1970 and 1990 than those elected during the fourth year (mean 28.3 ± 48.0 , $p = 0.01$). Both had significantly more publications than non-AOA members (mean 11.1 ± 19.4 , $p = 0.02$). Publication of the student's medical school thesis was also associated with a greater number of publications than thesis non-publication (mean 22.1 ± 37.5 vs 14.4 ± 30.0 , $p = 0.005$). These studies demonstrate that, at least at the institution studied, election to AOA and publication of the results of a research project were associated with increased publication rates in the medical field over the 20-year period following medical school graduation.

Little information exists regarding the prediction of academic productivity following graduation from medical school based upon academic performance or research activity during a student's medical school years. It has been demonstrated that scholastic success during medical school as evidenced by election to AOA^d, the National Medical Honor Society, is associated with increased selection of a career in academic medicine and may be predictive of successful completion of residency training [1-4]. Such individuals may be more likely to be successful in their careers in academic medicine [4]. It has also been noted that involvement in a research project during medical school may be associated with a continued interest in research-related pursuits [4, 5]. The purpose of the present study was to determine what, if any, relationship exists between election to AOA or publication of a medical school thesis and subsequent academic productivity as determined by authorship in the medical literature following medical school graduation.

METHODS

Study Sample

The 79 recipients of the doctor of medicine (M.D.) degree awarded by the Yale University School of Medicine in 1970 who were surviving on January 1, 1991 were the

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^d*Abbreviations used: AOA, Alpha Omega Alpha.*

subjects of the current study. Graduates of the Class of 1970 were defined as those listed in the official 1970 *Bulletin* of the Yale University School of Medicine [6].

AOA Membership

AOA membership of the graduates of the Class of 1970 was confirmed through records obtained from the Dean's Office of the Yale University School of Medicine.⁶ Members were elected to AOA during either their third ($n = 3$) or fourth year ($n = 12$) of medical school in accordance with a system incorporating weighted balloting by clinical and preclinical departments as well as medical school classmates.

Publications

Academic productivity was quantified by determining the number of articles authored or co-authored by individuals in the study population between 1970 and 1990 through utilization of a computerized search of the National Library of Medicine's Medline System. The Medline database contains more than 1.4 million references published in major biomedical journals during the study period. Authors' last names and initials as published in the official Yale University School of Medicine *Bulletin* were employed in the search process [6].

In those cases in which there appeared to be multiple authors with the same surname, who shared identical initials, articles were attributed to 1970 Yale Medical School graduate through identification of the graduate's field of specialization as determined by his or her type of residency training, or as documented by the American Board of Medical Specialties catalogue [7]. In some cases, reference to the Yale Medical School graduate's thesis title was of help (see below). If attribution was still uncertain, the original article was consulted to determine first names and institutional affiliations. There were no obvious instances in which articles could not be attributed to or excluded from being the work of a 1970 Yale Medical School graduate. In the case of women, the database was searched under both the surname with which the individual graduated, and any married name subsequently acquired as listed in the official Yale University alumni register [8].

Theses

In 1970, the Yale University School of Medicine required presentation to the faculty of an original thesis as a prerequisite for the granting of an M.D. degree. Official thesis titles were obtained from the 1970 *Bulletin* of the Yale University School of Medicine [6]. The Medline database was searched in order to determine which theses were published with a member of the study sample as author or co-author.

Data Analysis

The mean and standard deviation of the number of publications for the periods 1970–74, 1975–80, 1981–85, 1986–90, and 1970–90 were calculated. Data were analyzed to identify differences in the number of publications for the groups of individuals elected to AOA during their third and fourth years of school and for those not elected to AOA. Means and standard deviations of publications were also calculated for those individuals who published their medical school thesis and for those who did not. To determine the statistical significance of the differences between groups, the chi-square test, or the Fisher's exact test, were employed for categorical variables and the Wilcoxon 2-sample test was used for continuous variables. Where appropriate, analysis of variance for

⁶Winters, Betsy A.; Assistant Dean, Yale University School of Medicine, New Haven, Connecticut. Personal communication, November 4, 1980.

unbalanced groups was performed using the generalized linear modeling procedures in PC-SAS, version 6.04 (SAS Institute, Cary, NC).

RESULTS

Rates of Publication: Entire Class

There was a wide range in the total number of publications between 1970 and 1990 authored by members of the class of 1970 (Figure 1). During this period, 58 of the 79 (73.4%) graduates had at least one publication; 9 (11.4%) had more than 50 publications, and 1 had 182 cited publications as of 1990. The mean number of publications for the entire group was 17.1 ± 32.8 , and the median was 4. The average rate of publication for the group was lowest during the five year period following medical school graduation, and after 1975 continued at a relatively higher steady pace (Table 1).

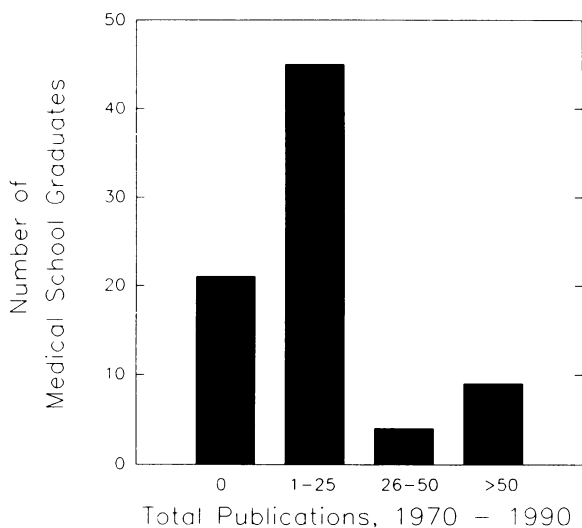


Figure 1. The total number of publications during the period 1970–1990 authored by the 79 surviving graduates of the Yale University School of Medicine Class of 1970.

Table 1. Publication rate, Yale Medical School Class of 1990 ($n = 79$).

	Publications/period	Graduates with at least one publication during period (%)
1970–1974	1.3 ± 2.0 (0–10) ^a	39 (49.4)
1975–1980	4.7 ± 8.5 (0–34)	43 (54.4)
1981–1985	5.6 ± 11.6 (0–68)	35 (44.3)
1986–1990	5.5 ± 13.1 (0–70)	36 (45.6)
1970–1990	17.1 ± 32.8 (0–182)	58 (73.4)

^aMean \pm SD (range).

Table 2. AOA membership and subsequent publication rate.

	Year of AOA election					
	3 (n = 3)	4 (n = 12)	<i>p</i> ^b	3 or 4 (n = 15)	Neither (n = 64)	<i>p</i> ^c
1970–1974	2.7 ± 2.1 ^a	2.3 ± 3.3	0.31	2.4 ± 3.0	1.1 ± 1.6	0.19
1975–1980	22.0 ± 15.4	8.0 ± 13.3	0.04	10.8 ± 14.3	3.3 ± 5.7	0.06
1981–1985	36.3 ± 27.5	8.8 ± 14.0	0.06	14.3 ± 20.0	3.6 ± 7.6	0.001
1986–1990	40.7 ± 27.2	9.2 ± 20.1	0.01	15.5 ± 24.1	3.1 ± 7.4	0.01
1970–1990	101.7 ± 69.6	28.3 ± 48.0	0.01	42.9 ± 58.5	11.1 ± 19.4	0.02

^aMean number of publications per period ± SD. ^bComparing publications, third year vs fourth year AOA. ^cComparing publications, AOA vs non-AOA.

Election to AOA and Publication Rate

The mean number of publications during the entire period studied ranged from 101.7 ± 69.6 for individuals elected to AOA during their third year of medical school to 11.1 ± 19.4 for non-AOA members (Table 2). Members of the class of 1970 elected to AOA during their junior year of medical school had significantly more publications in all time periods compared with individuals elected to AOA during their fourth year of medical school, and compared with those not elected to the AOA (Table 2). As a group, AOA members had significantly more publications than non-AOA members (Table 2). None of the third year AOA electees was a non-publisher. Between 1970 and 1990, 2 of 12 (16.7%) fourth year AOA electees failed to publish at least one article, while 19 of 64 (29.7%) of non-AOA members were non-publishers (NS, $p = 0.49$).

Publication of Thesis and Publication Rate

Those who published their thesis had a significantly greater number of publications over the entire period of the study than those who did not (Table 3). For the first ten years after graduation, individuals whose thesis was published had a significantly higher number of publications than those who did not (Table 3). A significant difference did not exist between the groups, however, during the second half of the study period (Table 3). During the period of the study, 21 of the 51 (41.2%) graduates who did not publish their thesis had no publications. Of the 28 graduates who had their thesis published, only three (10.7%) did not subsequently publish at least one additional article ($p = 0.005$). The median number of articles published by members of the class of 1970 who did not publish their thesis was 2, while the median number of articles published by those with a published thesis was 9 (9.5 for the 25 individuals who published more than their thesis alone) ($p = 0.005$).

Association of Election to AOA and Publication of Thesis with Subsequent Publication Rate

Individuals elected to AOA were not more likely than non-AOA members to have

Table 3. Thesis publication and subsequent publication rate.

	Thesis not published (<i>n</i> = 51)	Thesis published (<i>n</i> = 28)	<i>p</i>
1970–1974	0.6 ± 1.6 ^a	2.7 ± 1.9	0.0001
1975–1980	3.6 ± 7.3	6.7 ± 10.1	0.005
1981–1985	5.2 ± 10.4	6.5 ± 13.6	0.37
1986–1990	5.1 ± 12.7	6.2 ± 14.2	0.36
1970–1990	14.4 ± 30.0	22.1 ± 37.5	0.005

^aMean publication ± SD.**Table 4. Relationship of election to AOA and thesis publication to publication rate by 79 members of the Yale Medical School Class of 1970.**

		Thesis published		<i>p</i> ^c
		No (<i>n</i> = 51)	Yes (<i>n</i> = 28)	
AOA member	No (<i>n</i> = 64)	9.8 ± 20.1 ^a [1] ^b <i>n</i> = 41	13.3 ± 18.2 [5] <i>n</i> = 23	0.013
	Yes (<i>n</i> = 15)	33.0 ± 52.0 [9] <i>n</i> = 10	62.8 ± 71.9 [23] <i>n</i> = 5	0.07
<i>p</i> ^c		0.09	0.05	

^aMean publications ± SD, 1970–1990. ^bMedian number publications. ^cAnalysis of variance, comparing means of ranked data.

published their thesis (5/15 vs 23/64, $\chi^2 = 0.036$, $p = 0.8$). Individuals not elected to AOA had a significantly higher publication rate if they had published their thesis than if they had not (Table 4). Although AOA members who published their thesis did not have a statistically significantly higher publication rate than those who did not, they had a median of 23 publications compared with a median of only 9 for those who had not published their thesis (Table 4). Among those who did publish their thesis, election to AOA was associated with a significantly greater number of publications than those who were never elected to AOA (Table 4). Among those whose thesis was never published, election to AOA was not associated with a statistically significant increase in publication frequency although the median number of publications in this group was nine compared with only one in the non-thesis publishing, non-AOA group (Table 4). A regression model to predict total publications included election to AOA (partial $R^2 = 0.077$; $p = 0.001$), time after graduation (partial $R^2 = 0.023$; $p = 0.005$) and thesis publication (partial $R^2 = 0.01$; $p = 0.06$). When the interaction term for those three variables was added to the model, the model R^2 increased from 0.109 to 0.125. Thesis publication was associated with early

publication productivity following graduation, while AOA election was associated with later productivity. The most productive graduates, therefore, were those who had been elected to AOA and had published their thesis.

DISCUSSION

The present study, performed about halfway through the professional lives of a group of individuals from the graduating class of a single medical school, demonstrated a pronounced association between success during medical school as indicated by election to AOA and subsequent success in having manuscripts published in the medical literature. Furthermore, election to AOA during the third year of school was associated with a greater number of publications than was selection during the fourth year of medical school. While most previous studies have demonstrated little correlation between academic success during medical school and subsequent performance during internship or throughout one's career [9, 10], both Kron and Erlandson [1, 2] demonstrated a correlation between election to AOA during medical school and successful completion of surgical residency training. It has also been demonstrated that individuals elected to AOA are, at the time of medical school graduation, more likely to have plans to enter academic medicine and to have a major career commitment to research activities [3].

Brancati et al. reported that AOA electees graduating from Johns Hopkins Medical School between 1948 and 1964 were significantly more likely to enter academic medicine than were non-electees and that these individuals had significantly more citations of their work in the medical literature and, on the average, attained higher academic rank than did non-AOA electees [4]. Inasmuch as increased rates of publication are also a marker of professional activity in academic medicine, the present study confirms the suggestion that AOA members do indeed enter academic medicine at a higher rate than non-AOA members. Rate of publication is, at best, only a crude marker of academic success. It was beyond the scope of the present study to systematically analyze other evidence of academic success including professional rank, attainment of tenured status, number and size of research grants, or election to honorary national bodies. Such information was not universally available for each of the graduates of the Yale Medical School Class of 1970. Additionally, the number of publications in professional journals is by no means the only, let alone the most important, measure of the success of a physician's career. The current study leaves unassessed the clinical, educational, and administrative activities of the study group. Many excellent and highly successful clinicians and medical teachers never publish a single manuscript.

We also evaluated the association of publication of a medical school thesis with subsequent publication rate. All graduates of Yale Medical School in 1970 were required to present a dissertation to the faculty prior to graduation. The requirement for a medical school thesis began at Yale in the mid-1800's [11]. Other elements of the curriculum operative for the Class of 1970 included the lack of a formal grading system and mandatory passage of the Parts I and II of the National Board of Medical Examiners examination [12]. Medical student research activity occurred among selected individuals during the late 1960's at some other medical schools, but a mandatory dissertation was not required elsewhere. Subsequent to graduation, many Yale Medical School students published their thesis as primary author or co-author. A greater rate of subsequent publication existed among these individuals compared to non-publishers, even if the published thesis itself was subtracted from the individual's total number of publications. This increased rate was present for only the first ten years after graduation. It would appear that working closely with a faculty member in preparing a manuscript for formal publication may have provided such individuals with certain skills that took non-thesis publishers a longer time

to acquire after medical school graduation. Once such skills were acquired, both groups published at similar rates.

Publication of a thesis was associated with a greater number of publications over the period of the study among individuals not elected to the AOA compared with non-AOA members who did not publish their thesis. In this group, thesis publication was associated with subsequent increased publication rate. Among those individuals who published their thesis, election to AOA was associated with a significantly greater number of publications compared with non-AOA members. It has been previously demonstrated that individuals with experience in research during their medical school years are more likely to be involved in postgraduate research activity than those without such an experience [1, 4]. In situations in which all students have a required research project, however, the current study suggests that actual publication of the results obtained during the medical school project may be associated with greater subsequent publication rate than simple participation in the research activity alone.

Whether the results of the current study can be generalized in the current era to other medical schools and their student bodies remains to be determined. In 1970, Yale Medical School was an institution emphasizing medical student independence and mandatory research activity. With the absence of medical school examinations, the method of selection to AOA at Yale strongly emphasized performance assessment by the academic departments and medical school peers. Approximately 30% of graduates each year went on to academic careers, an unusually high proportion compared to many medical schools [11]. The results of the current study do suggest, however, that certain markers of academic success during medical school, including AOA election and publication of a student thesis, can be correlated with subsequent increased levels of academic productivity as assessed by publication rates in the medical literature.

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