Contribution of Turkish Researchers to the World's Biomedical Literature (1988-1997)*

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The contribution of Turkish researchers to positive sciences is increasing. Turkish scientists published more than 5.100 articles in 1998 in scientific journals indexed by the Institute for Scientific Information's Science Citation Index*, which elevated Turkey to the 25th place in the world rankings in terms of total contribution to science. In this paper, we report the preliminary findings of the bibliometric characteristics (authors and affiliations, medical journals and their impact factors, among others) of a total of 8.842 articles published between 1988 and 1997 by scientists affiliated with Turkish institutions and indexed in MEDLINE, a well-known biomedical bibliographic database.*

Introduction

Currently, there are some 40,000 scientific journals published regularly throughout the world. More than one million articles appear in those journals every year. The number of scientific publications is continually increasing due to the rapid developments in science and technology. Scientists specializing in certain fields ought to follow, scan and read increasingly large numbers of publications. In 1840s, German scientists protested the sheer number of medical journals published then, complaining that they were unable to keep up with 13 journals![1] Compare this with 4300 biomedical journals indexed in MEDLINE Plus database of the National Library of Medicine (NLM). The MEDLINE Plus database contains more than 11 million bibliographic citations.** Full texts of articles of some 400 medical journals are accessible through the Internet. Some 200

* A slightly different version of this paper was delivered (in Turkish) at an international symposium organized by the Turkish Librarians' Association on the occasion of its 50th anniversary and appeared in the proceedings.

** This figure comes from the web site of the National Library of Medicine of USA (http://www.nlm.nih.gov/medlineplus/medline.html).

medical journals are currently being published in Turkey.[2] Articles appearing in those journals are selectively indexed in *Türk Tıp Dizini* (Turkish Medical Index).

The number of articles published in international journals and authored by scientists affiliated with Turkish research institutions have increased tremendously in recent years. The contribution of Turkish researchers to the world science has increased accordingly: Turkey ranked 34th in 1995 in the world in terms of its contribution to the world science, 29th in 1996, 27th in 1997, and 25th in 1998 (with more than 5100 articles.[3] It is observed that the number of biomedical publications in Turkey is increasing faster than that of engineering and other non-medical fields.[4] This increase might be one of the main causes of the steep rise in Turkey's ranking that we have been witnessing in recent years.

This paper is an attempt to analyze the bibliometric features (number of authors, authors' affiliations, journals, etc.) of 8,842 publications whose first authors are affiliated with a Turkish research institution. All articles were published between 1988-1997 and indexed in the MEDLINE database of the National Library of Medicine.

Data Gathering and Analysis

We used Melvyl, the online catalog of the University of California, to perform comprehensive searches on MEDLINE. We identified all the articles whose first authors were affiliated with a Turkish institution and were published between 1988-1997 in journals that were indexed in MEDLINE. We issued the following Melvyl command on MEDLINE: “FIND ADDRESS TURK OR TURKEY OR TURKISH OR TURKIYE OR TURKYE OR TURKEI OR TURQUIE OR TURCHIA AND DATE (19XX)”. Using

Melvyl's "mail" command, we then had the detailed search results sent to our electronic mail address. Figure 1 shows the fields that each MEDLINE record contains.

Figure 1. Sample Melvyl MEDLINE Record

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Author:         Yilmazlar S; Hanci M; Oz B; Kuday C.
Address:        Department of Neurosurgery, Istanbul University Cerrahpasa Medical
                  Faculty, Turkey.
Title:          Blood degradation products play a role in cerebral ischemia caused
                  by acute subdural hematoma.
Journal:        Journal of Neurosurgical Sciences, 1997 Dec, 41(4):379-85.
Unique ID:      98216486.
Abstract:       Type D 1 LONG AB to see abstract.
Language:       English.
CAS;EC No.:     0 (Silicones)
Subject:        Animal.
               *Blood Transfusion, Autologous -- adverse effects.
                Cerebral Ischemia -- etiology.
                Cerebral Ischemia -- pathology.
               *Cerebral Ischemia -- physiopathology.
                Death.
                Female.
                Hematoma, Subdural -- complications.
                Hematoma, Subdural -- pathology.
               *Hematoma, Subdural -- physiopathology.
                Intracranial Pressure.
                Motor Activity.
                Rats.
                Rats, Sprague-Dawley.
                Silicones.
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We created raw text files for each year's worth of data by combining files that were sent, due to their large sizes, separately to our address. We then ran one of the Unix text processing programs (awk) on those files to extract the needed fields.[5] Thus we created separate files for 10 years' worth of data for authors, addresses, subjects, journals, language, type of contribution, and MeSH (Medical Subject Headings). We used a commercial spreadsheet program to analyze data. We removed all the white spaces between author names, addresses, and journal names for sorting purposes. Through an awk program, we found out the number of publications that each author contributed to both as the first and joint author, and the number of articles with Turkish affiliations that appeared in each journal. We sorted the results separately by author name, by the number

of publications per author, by journal name, and by the number of publications per journal. We used a commercial spreadsheet package to calculate means and standard deviations, and create related graphics.

Limitations of the Study

We used the term "publication" in this study so as to encompass all types of contributions (e.g., original and review articles, notes, book reviews, letters to the editor and editorials) in biomedical journals that were indexed in MEDLINE. The analysis covers a total of 8.842 publications that appeared in international biomedical journals and were indexed in MEDLINE. Publications whose first authors not based in Turkey were not included in this study, as MEDLINE does not list the addresses of joint authors. In other words, contributions of Turkish researchers as joint authors (but not first authors) were excluded. Hence, it can be safely assumed that the number of publications Turkish researchers contributed to (either as first or joint authors) is much higher than what we report here. In addition, contributions of Turkish authors published in biomedical journals that are not indexed in MEDLINE are not included, either. Of 8.842 publications, a few may have foreign researchers listed as first authors as they were based in Turkey as visiting scholars at the time of writing up their contributions. Needles to say, some of the publications that we analyzed in this study list foreign researchers as joint authors.

Findings

As we indicated earlier, the total number of biomedical publications which Turkish researchers contributed to as first authors was 8,842. The distribution of those

publications is given in Fig. 2. As Fig. 2 shows, the number of publications has shown more than a seven-fold growth over the years, thereby increasing from 237 in 1988 to 1709 in 1997. This growth parallels with Turkey's overall contribution to the world science (ranked 25th in 1998).

An overwhelming majority (98.7%) of 8.842 publications were written in English. The numbers of publications written in French and German were 53 (0.6%) and 36 (0.4%), respectively. Publications written in languages other than English, French and German were only 11.

Table 1 lists the figures for the numbers of publications and authors per year, and the mean number of authors per publication. The mean number of contributors to a biomedical publication was 4.1. This figure has increased from 3.6 in 1988 to 4.6 in 1997 (Fig. 3).

Table 1. Numbers of Publications and Contributors, And Mean Number of Contributors Per Publication (1988-1997)

Year	*Number of publications*	*Number of Authors*	*Mean Number of Contributors Per Publication*
1988	237	858	3,6
1989	269	1.000	3,7
1990	443	1.611	3,6
1991	548	2.155	3,9
1992	681	2.826	4,1
1993	843	3.604	4,3
1994	932	4.011	4,3
1995	1.172	5.174	4,4
1996	1.608	7.509	4,7
1997	1.709	7.830	4,6
Total	**8.442**	**36.578**	**4,1**

The distribution of publications per number of contributors is given in Fig. 4. A total of 1.759 publications had four contributors, 1.648 had five, and 1.473 had three. Three-, four-, and five-author publications constituted 60% of all publications.

Table 2 lists the names and numbers of publications for authors who contributed to 30 or more publications over the ten-year period. Figures represent the contributions of researchers as both first and joint authors.

Table 2. Authors with 30 or More Publications

Number of publications	*Author Name*	*Number of publications*	*Author Name*	*Number of publications*	*Author Name*
96	Buyukpamukcu N	40	Ercan MT	33	Ozgen T
95	Tan U	39	Yalcin S	33	Ozalp I
89	Haberal M	38	Piskin E	33	Akhan O
88	Ayhan A	38	Ozkutlu S	32	Telatar H
81	Hicsonmez A	37	Gurses N	32	Sarica K
68	Tanyel FC	36	Tuncer ZS	32	Gedikoglu G
68	Gokmen O	36	Ozen H	32	Ekici E
64	Sener RN	36	Gunduz K	31	Yegen BC
64	Bilgin N	35	Turgut M	31	Hincal AA
50	Ozcan OE	35	Topaloglu H	31	Bayazit K
50	Coskun T	35	Ozturk Y	31	Baltaci S
50	Akdas A	35	Ozen S	30	Senocak ME
49	Erbengi A	35	Oktay S	30	Sahin A
47	Balkanci F	35	Kirkali Z	30	Pasaoglu I
46	Saatci U	35	Gunhan O	30	Onol B
45	Gurgey A	34	Yilmaz E	30	Ilker Y
42	Ruacan S	34	Tasdemir O	30	Ercan ZS
41	Yazici H	34	Arslan G	30	Dundar S
41	Durak I	33	Remzi D	30	Altay C
41	Bakkaloglu A				

The first authors of a total of 7.427 publications (88%) are affiliated with Turkish universities. Figure 5 and Table 3 show the distribution of publications whose authors come from universities based in the largest three cities of Turkey, namely İstanbul, Ankara, and İzmir. Researchers based in Ankara universities contributed to, as first authors, a total of 3.373 publications, constituting the 45.4% of all publications generated

by academia. Researchers at İstanbul and İzmir universities follow those of Ankara with 1.391 (18.6%) and 770 (10.4%) publications, respectively.

Table 3. Number of Publications Generated by Researchers Based in the Three Largest Cities in Turkey

City/University	*Number of Publications*	*Share Within Total (%)*
Ankara		
Hacettepe	1.718	23,1
Ankara	773	10,4
Gazi	450	6,1
GATA	240	3,2
ODTÜ	135	1,8
Başkent	51	0,7
Bilkent	5	0,1
Fatih	1	0,0
Total	3.373	45,4
İstanbul		
İstanbul	946	12,7
Marmara	394	5,3
Boğaziçi	39	0,5
İTÜ	9	0,1
YTÜ	3	0,0
Total	1.391	18,6
İzmir		
Ege	507	6,8
Dokuz Eylül	261	3,5
İzmir YTE	2	0,0
Total	770	10,4
Other Provinces		
Total	1.893	25,5
Grand Total	**7.427**	**100,0**

Table 4 lists the number of biomedical publications produced by all universities along with the Gülhane Military Medical Academy between 1988-1997. Hacettepe University in Ankara ranks first with 1.713 publications and produces almost one-fourth (23.1%) of all biomedical publications. İstanbul University follows Hacettepe with 946 publications (12.7% of all publications) along with Ankara and Aegean Universities (773 and 507 publications, respectively). In other words, more than half (53%)of all biomedical

publications were produced by the abovementioned four universities. Based on *Science Citation Index* data for the years 1981 through 1993, Onat and Yazıcı found that the weight of the Hacettepe, İstanbul, Cerrahpaşa (İstanbul) and Ankara medical schools in terms of number of publications within the total has decreased from 84% to 45%. The finding we obtained in this study with regards to the productivity of those four medical schools (46%) is similar to that of Onat and Yazıcı.[6]

Table 4. Number of Biomedical Publications of Turkish Universities (1988-1997)(N=7427)

University	*# Of publications*	*Share within total (%)*	*University*	*# Of publications*	*Share within total (%)*
Hacettepe	1718	23,1	Fırat	46	0,6
İstanbul	946	12,7	Osmangazi	42	0,6
Ankara	773	10,4	Boğaziçi	39	0,5
Ege	507	6,8	Yüzüncü Yıl	34	0,5
Gazi	450	6,1	Trakya	29	0,4
Marmara	394	5,3	Adnan Menderes	24	0,3
Dokuz Eylül	261	3,5	Gaziantep	23	0,3
GATA	240	3,2	Kocaeli	19	0,3
Çukurova	239	3,2	Celal Bayar	18	0,2
KTÜ	198	2,7	Pamukkale	10	0,1
Erciyes	197	2,6	İstanbul Teknik	9	0,1
Atatürk	188	2,5	Sütçü İmam	7	0,1
Ondokuz Mayıs	145	2,0	Bilkent	5	0,1
Akdeniz	138	1,9	Süleyman Demirel	5	0,1
Uludağ	138	1,9	Harran	3	0,0
ODTÜ	135	1,8	İzmir YTE	2	0,0
Cumhuriyet	92	1,2	Yıldız	2	0,0
Dicle	84	1,1	Abant İzzet Baysal	1	0,0
Selçuk	75	1,0	Fatih	1	0,0
İnönü	73	1,0	Kırıkkale	1	0,0
Anadolu	63	0,8	Kafkas	1	0,0
Başkent	51	0,7	Yıldız Teknik	1	0,0
			Total	**7427**	**100,0**

Table 5 gives the number of publications produced by Turkish medical schools (excluding pharmacy, dentistry, nursing, and others), total number of faculty members (professors, associate and assistant professors) and their average annual and five-year productivity levels. Among the medical schools, Hacettepe ranks first in terms of both the total number of publications (1394) and the productivity level (0,43 publications per year) (Fig. 6). Hacettepe Medical School produces almost one-fourth of all the publications produced by the Turkish medical schools. Yurtsever points out the possibility that such evaluations may either meaninglessly penalize or promote medical schools with fewer faculty members.[7]

Table 5. Total Number of Publications, Total Number of Faculty Members, and Number of Publications Per Faculty Member in Turkish Medical Schools

University	*# Of publications (1997-1998)*	*Total number of faculty members*	*# Of publications / Number of faculty members*	*# Of publications / Number of faculty members / 10 (yrs)*
Adnan Menderes	21	43	0,49	0,05
Akdeniz	131	147	0,89	0,09
Ankara	563	369	1,53	0,15
Atatürk	166	132	1,26	0,13
Başkent	51	40	1,28	0,13
Celal Bayar	18	31	0,58	0,06
Cumhuriyet	82	99	0,83	0,08
Çukurova	228	188	1,21	0,12
Dicle	75	115	0,65	0,07
Dokuz Eylül	247	118	2,09	0,21
Ege	350	286	1,22	0,12
Erciyes	184	140	1,31	0,13
Fatih	1	9	0,11	0,01
Fırat	40	80	0,50	0,05
Gazi	299	207	1,44	0,14
Gaziantep	22	45	0,49	0,05
Hacettepe	1.394	324	4,30	0,43
Harran	3	20	0,15	0,02
İnönü	65	28	2,32	0,23
İstanbul (Cerrahpaşa)	304	286	1,06	0,11
İstanbul (İstanbul Tıp)	479	357	1,34	0,13
KTÜ	188	103	1,83	0,18
Kocaeli	17	62	0,27	0,03
Marmara	264	111	2,38	0,24
Ondokuz Mayıs	139	122	1,14	0,11
Osmangazi	70	142	0,49	0,05
Pamukkale	10	75	0,13	0,01
Selçuk	62	148	0,42	0,04
Süleyman Demirel	4	43	0,09	0,01
Trakya	23	99	0,23	0,02
Uludağ	110	173	0,64	0,06
Yüzüncü Yıl	32	69	0,46	0,05
GATA	218	364	0,60	0,06
Total-Average	**5.860**	**4.576**	1,28	0,13

Note: The figures for the number of faculty members were taken from Student Selection and Placement Center's annual statistics for the 1996-1997 academic year.[8] The number of publications per faculty member is likely to be lower than what is reported here as medical schools hired relatively more faculty members in recent years. It should also be noted that some of the universities listed in the table were established after 1990s (i.e., Adnan Menderes, Celal Bayar, Harran, Kocaeli, Pamukkale and Süleyman Demirel universities were established in 1992; Başkent and Osmangazi in 1993; Fatih in 1994; and Yeditepe in 1996).[9]

Researchers based in 126 non-university establishments produced a total of 1015 publications (12% of the total number of publications). Table 6 lists the most prolific 20 institutions. Researchers at Ankara Numune Hospital ranked first among non-university institutions with a total of 132 publications. In other words, Ankara Numune Hospital researchers produced some 13% of the total number of publications outside academia. Researchers affiliated with Ankara Higher Specialty Hospital (95), Dr. Zekai Tahir Burak Women's Hospital (92) and Ankara Social Security Institution Hospital (55) followed Ankara Numune Hospital. Researchers affiliated with the first five institutions listed in Table 6 produced some 43% of all non-university publications. The first ten institutions produced 58%, and the first 20 produced 75% of all non-university publications.

Table 6. The Most Prolific Non-University Institutions in Biomedicine (1988-1997)

Institution	*#Of publications*	*Percentage within total non-university publications (%)*
Numune Hospital-Ankara	132	13.0
Higher Specialty Hospital-Ankara	95	9.4
Dr. Zekai Tahir Burak Women's Hospital-Ankara	92	9.1
SSK Hospital-Ankara	58	5.7
Turkish Organ Plantation and Burns Foundation Hospital-Ankara	55	5.4
Ministry of Health Ankara Hospital	45	4.4
S. Ulus Children's Hospital-Ankara	37	3.6
State Hospital-İzmir	25	2.5
SSK Hospital-Tepecik-İzmir	25	2.5
SSK Hospital-Okmeydanı-İstanbul	24	2.4
Oncology Hospital-Ankara	22	2.2
Şişli Children's Hospital-İstanbul	21	2.1
State Hospital-Taksim-İstanbul	21	2.1
TÜBİTAK-MAM-Gebze-Kocaeli	20	2.0
Turkish Health and Treatment Foundation Hospital-Ankara	17	1.7
Turkish Railways Hospital-Ankara	17	1.7
SSK Hospital-Ankara	16	1.6
Atatürk Chest Diseases and Surgery Center-Ankara	13	1.3
Numune Hospital-Haydarpaşa-İstanbul	13	1.3
Ankara Hospital -Ankara	12	1.2

Zeynep Kamil Women’s and Children’s Hospital-İstanbul	12	1.2
Chest Surgery and Research Center-Koşuyolu-İstanbul	11	1.1
Total	783	77.1
Other	232	22.9
Grand Total	**1015**	**100.0**

Some 36 non-university institutions based in Ankara published 672 publications. This figure constitutes two thirds (66%) of all publications produced by institutions outside the academia. Those 39 non-academic institutions based in İstanbul produced a total of 192 publications, 19% of all publications generated by non-academic institutions. Almost 8% (78 publications) of all non-university contributions were produced by 12 institutions based in İzmir. In other words, 87 non-academic institutions based in Turkey's three largest cities, namely, İstanbul, Ankara and İzmir, generated 942 publications, almost 93% of all non-university contributions. The rest (7% or 73 publications) of the non-university contributions were produced by some 39 non-academic institutions based in other cities.

Public institutions generated an overwhelming majority of non-university contributions. The contribution of the private hospitals, clinics, and professional associations constituted a mere 5% (51 publications) of all non-academic publications.

Contributions by Turkish researchers appeared in 1190 different biomedical journals. There were 19 journals publishing 50 or more contributions by Turkish researchers. Some 19% (1606 publications) of all contributions by Turkish researchers appeared in those 19 journals. The names and the 1996 impact factors of 19 journals with 50 or more contributions are given in Table 7.[10]

Table 7. Journals Publishing 50 or More Contributions by Turkish Researchers.

Journal	*Impact factor (1996)*	*# Of contributions by Turkish researchers*
International Urology and Nephrology	-	234
Turkish Journal of Pediatrics	0,130	120
British Journal of Urology	1,005	114
International Journal of Neuroscience	-	107
Transplantation Proceedings	0,850	100

Journal of Pediatric Surgery	1,062	97
Acta Paediatrica Japonica	0,049	83
Neurosurgical Review	0,200	77
Acta Neurochirurgica	0,498	72
General Pharmacology	0,818	72
Clinical Nuclear Medicine	0,437	64
International Journal of Gynaecology And Obstetrics	0,387	64
Japanese Heart Journal	0,186	64
European Urology	0,981	62
Pediatric Radiology	0,489	59
Journal of Marmara University Dental Faculty	-	57
European Journal of Pediatric Surgery	0,326	56
Angiology	0,448	53
European Journal of Obstetrics Gynecology and Reproductive Biology	0,537	51
Total		1606 (19%)
Other journals		6836 (81%)
Grand Total		**8.442**

Conclusion

We summarized the preliminary findings of our research that was based on 8.442 biomedical publications that were contributed to by Turkish researchers and appeared in MEDLINE between 1988-1997. A more detailed evaluation of our findings is planned. We believe that we can gain a better understanding about the contributions of Turkish researchers to the world's biomedical literature.

Here are some of the research questions that we plan to answer in the second phase of this research: the distributions of contributions by type (i.e., original articles, book reviews, letters to editor, etc.) and by sub fields within biomedicine; contributions of various departments (medicine, pharmacy, dentistry, nursing, etc.) of universities and the number of publications per faculty member by universities; contributions of researchers

based in public hospitals and clinics; the relationship between impact factors of journals in which contributions of Turkish researchers appeared and citations to those contributions; the availability of those journals in Turkish medical school libraries and its likely impact on collection development policies.

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8. *1996-1997 öğretim yılı yükseköğretim istatistikleri* (Higher education statistics of 1996-1997 academic year). Student Selection and Placement Center, Ankara, 1997, Table 24.

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