Scientific productivity and group size: A bibliometric analysis of Norwegian microbiological research

PER O. SEGLEN, DAG W. AKSNES

Norwegian Institute for Studies in Research and Higher Education (NIFU), Oslo (Norway)

To analyse the relationship between research group size and scientific productivity within the highly cooperative research environment characteristic of contemporary biomedical science, an investigation of Norwegian Microbiology was undertaken. By an author-gated retrieval from ISI’s database National Science Indicators on Diskette (NSIOD), of journal articles published by Norwegian scientists involved in microbiological research during the period 1992-1996, a total of 976 microbiological and 938 non-microbiological articles, by 3,486 authors, were obtained. Functional research groups were defined bibliometrically on the basis of co-authorship, yielding a total of 180 research groups varying in size from one author/article to 180 authors/articles (all authors associated with a group during the whole five-year period were included, hence the large group size). Most of Norwegian microbiological research (73% of the microbiology articles) appears to be performed by specialist groups (with ≥70% of their production as microbiology), the remainder being published by groups with a broader biomedical research profile (who were responsible for 95% of the non-microbiological articles). The productivity (articles per capita) showed only moderate (Poisson-distributed) variability between groups, and was remarkably constant across all subfields, at about 0.1 article per author per year. No correlation between group size and productivity was found.

Introduction

Scientific productivity is influenced by a large number of factors, including individual characteristics such as age, gender, psychological traits and educational background, as well as structural features like funding, institutional context, and the organization of the actual research. Over the last few decades, science has increasingly become performed by research groups rather than by individual scientists, adding importance to issues like the relationship between scientific productivity (i.e., publications per capita) and the size of the research group. Scientific collaboration would be expected to increase both the quality and the quantity of the scientific output, but empirical studies, particularly on the latter aspect, have actually produced quite discrepant results. Whereas some studies have reported a positive correlation between

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group size and productivity, 5-7 others found a negative correlation. 8,9 Stanekiewicz 10 suggested a team size of 3-5 scientists to be optimal, but emphasized that the cohesiveness of the group as well as the experience of the group leader strongly determined whether the size/productivity correlation was positive or negative. On the other hand, several carefully conducted studies found that productivity was independent of group (team) size over a wide size range. 11-13

Contemporary research, particularly in medicine and the natural sciences, is both more highly structured and more extensively collaborative than when the studies referred to above were undertaken, suggesting that a re-examination of the group size/productivity relationship might be of interest. The typical research group still has a core team consisting of tenured staff and students at various levels (graduate, doctoral and postdoctoral), but in addition there is usually a more peripheral layer of visiting scientists and cooperating domestic and foreign colleagues. These wider cooperative units, which can be identified on the basis of co-authorship, are the actual research-performing units, which may reflect the realities of the scientific process more accurately than do the core teams. Such functional research groups can be quite large, particularly if they are bibliometrically defined for a period of time that exceeds the residence duration of the average group member.

In the present study, we have analysed the group structure of Norwegian microbiological research on the basis of a large, representative sample of journal articles obtained by author-gated retrieval 14,15 from the ISI (Institute for Scientific Information) database National Science Indicators on Diskette (NSIOD). Using a research group definition based on co-authorship, the relationship between scientific productivity and group size has been examined. The material has also allowed us to assess productivity across scientific subfields and in relation to the thematic profile of the research groups. Furthermore, the variability in productivity at the group level has been analysed.

Methods

Acquisition and processing of bibliometric data

The database product National Science Indicators on Diskette (NSIOD; 1997 edition) from the Institute for Scientific Information (ISI, Philadelphia, USA) was used as a source of primary data. NSIOD contains aggregated publication and citation counts from 6,155 different journals. The standard version used in our study provides national data from 24 different fields and subfields within the sciences and social sciences.