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Surgical Scientific Publication and the 1991–1995 War in Croatia

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A B S T R A C T

The aim of this study was to evaluate surgical scientific publication in relation to the 1991–1995 war in Croatia, based on the articles indexed in Medline database that were published in 1980–2005 period. The number of articles was extracted from PubMed and analysed with trend analysis, which is preferred analytic approach over calculation of crude publication rates. The results indicate sporadic pre-war output, which was almost completely reduced by the onset of war. During wartime, a significant increasing trend in the number of published surgical articles that were related to warfare was detected (p=0.003). During the post-war period a gradual shift towards surgical articles that were not related to warfare was detected, also marked by the significant increasing trend (p=0.027). Both trends were significantly steeper than the overall Croatian biomedical output, suggesting that surgical scientific articles were being published more dynamically than in other biomedical areas in Croatia. The results suggest that war in Croatia has had a strong modifying effect on the surgical scientific output.

***Key words**: surgery, Croatia, war, science, output, scientific publication*

Introduction

The war in Croatia begun in 1991, affecting more than a third of the country, causing a substantial number of casualties and displaced people, and breakdown of the infrastructure in the affected areas[1–3]. In such conditions, a substantial stagnation or even decrease in the scientific output was recorded in various scientific fields[4,5]. However, it has been previously documented that the nature of the war can affect the pattern and the dynamics of the scientific output[6], and that the outbreak of war initially causes the reduction of the inventiveness that is often followed by a sudden surge and increase in the scientific output[7].

The effects of war on medical and health related research seem to be much less clear, without general agreement as to whether the wars have positive or negative effect on the inventiveness and scientific productiveness in medicine[8]. In contrast to many fields of medicine and other health-related services, in wartime surgery we could expect to encounter the increasing trend of professional development due to the exposure to warfare. This is primarily related to increased workloads and management of the increased number of warfare related injuries. This effect has been reported from a number of previous conflicts, suggesting that some of the greatest surgical advances and scientific breakthroughs in surgery occurred during or around major wartime periods[9–12], and that the development of systems for trauma care in e.g. United States has been inextricably linked to wars[13]. A study from Lebanon suggested that the large number of factors may affect wartime-related publication output, and that country-specific rates must be calculated and compared in order to establish a more general pattern[14].

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A more detailed analysis of available studies from Croatia provides somewhat conflicting results. Firstly, a number of studies have reported or suggested strong patterns of emigration and net loss of research personnel and nearly graduated students, or showing their willingness to emigrate[15–19]. At the same time, studies have reported a decrease or stagnation in the overall scientific output[4,20], while the number of articles in (bio)medicine was shown to increase during war and post-war period[21]. However, neither of those scientometric studies was adjusted to the overall increase in the number of indexed articles[22], thus causing a false overestimation of the research output estimates in sequential analysis (comparison of pre-, wartime and post-war publication output).

The aim of this study was to investigate the wartime related surgical scientific output in Croatia and to investigate whether the war had modifying effect on the surgical scientific output.

Materials and Methods

We evaluated the surgical scientific output in Croatia during the 1980–2005 period, based on the published scientific articles that were indexed in the Medline database (the search was performed in the PubMed website; www.pubmed.com). The initial search strategy was aimed at identifying all of the potential published articles. This was done by using a broad set of keywords: (surgery OR surg* OR operat* OR operation) AND Croatia. The initial search resulted in a total of 1290 articles, published between 1980-01-01 and 2005-12-31. No other limits in PubMed were used (except for the publication date), in order to obtain the maximum coverage and not to miss studies by limiting the search terms. Following, all identified articles were carefully checked, and those that were not directly related to surgery, non-surgical articles that only mention surgery as a potential treatment option, as well as dental surgery articles were excluded from the analysis. The detailed search and exclusion of irrelevant articles was always performed by two researchers independently, whose results were later compared and consensus agreement was made for those that were differently classified between the two researchers. Furthermore, in order to maximize the search results we also performed a broadened search for those articles that were published prior to the 1990s. For this period we performed a Medline search with additional keywords; either by using names of major cities in Croatia where these articles might have originated from (such as »Zagreb«, »Rijeka«, »Osijek« or »Split«), or using »Yugoslavia« as an additional keyword (as older articles often referred to Yugoslavia as a country of origin). All searches were made with both MeSH terms and keywords only, thus maximizing the search results. After the entire search process, we managed to identify and include a total of 238 articles that were related to surgery. These articles were subsequently classified in two groups; articles related to war, and those that were not related to war (later being referred to as the »non-war articles«).

The entire study was based on the secondary and tertiary data from other publications, so no ethical permission was sought. The search was limited to articles that were published during the 26-years period (1980–2005). Three periods were defined; pre-war period (defined as 1980–1990), war and early post-war period (defined as 1991–1998; wartime period was extended for approximately half of its duration, in order to account for the immediate post-war conditions and publication lag), and finally, post-war period (defined as 1999–2005).

The data were presented as the number of identified articles for every study year, divided into two groups: the war-related and non-war articles. The analysis was performed by the linear regression fit, and slope analysis in analysis of variance. Slope analysis was initially performed to detect significant trend (deviation from the horizontal line), while in the later analysis stage trends were adjusted to the total number of published biomedical articles related to Croatia, which were indexed in the Medline database, in order to show the dynamics of surgical publications in relation to the overall scientific output. Analysis was performed in SPSS package, version 12.0.0 (SPSS Inc., Chicago, IL, USA), with significance level set at $p<0.05$.

Results

A total of 238 surgical articles were published during the 1980–2005 period. Most articles were published in the post-war period (95, 39.9%), followed by the wartime period (87, 36.6%), while the least articles were identified during the pre-war period (56, 23.5%). During the entire investigated period (1980–2005) a significant increasing trend in the overall number of published articles was recorded ($p<0.001$, $\beta=0.73$).

Pre-war period was characterised by the sporadic publication output, with a sudden increase just before the war outbreak (1989 and 1990). Large output during these two years might be related to the appearance of the journal *Acta Chirurgica Yugoslavica* in Medline. A total of 7 and 3 articles were published in this journal in the years 1989 and 1990, respectively, with no records related to Croatia in any other investigated year. During the pre-war period a significant increasing trend was recorded in the number of published (non-war) articles ($p=0.018$, $\beta=0.69$).

The onset of war in 1991 coincides with a substantial reduction in the overall surgical scientific output. After this initial reduction, a sudden increase in the warfare-related articles was recorded, which represented a total of 90.8% of articles published during the 1991–1998 period. During wartime, a constant pattern without a detectable trend was recorded for non-war articles ($p=0.276$, $\beta=0.43$), while both overall surgical output and wartime articles exhibited a strong increasing trend (overall: $p=0.002$, $\beta=0.90$; wartime: $p=0.003$, $\beta=0.89$). Adjustment of the wartime articles to the total number of biomedical articles related to Croatia resulted in even stronger increasing trend ($p<0.001$, $\beta=0.94$).

The post-war period was marked by a gradual shift, with non-war articles becoming the main focus of the surgical scientific publication. Neither total ($p=0.370$, $\beta=0.40$) nor wartime articles ($p=0.179$, $\beta=-0.57$) exhibited a significant trend in this period. However, non-war articles exhibited a significantly increasing trend ($p=0.027$, $\beta=0.81$), which was even stronger after adjustment to the total number of published articles related to Croatia that were indexed in Medline ($p=0.020$, $\beta=0.83$).

Discussion

The results of this study suggest that the warfare had a profound effect on the surgical scientific output in Croatia. After the outbreak of war, surgical scientific output has almost come to a complete stop, similar to the stagnation and reduction in other scientific fields[4]. This pattern was soon replaced by an increasing publication trend in surgical articles, which begun two years after the war outbreak, culminated in 1997, and then decreased in the later years. In contrast to wartime and the early post-war period, surgical scientific publication in the post-war period (ever since 1999) was slowly shifting more and more towards non-wartime related subjects.

Analysis of the publication output during the war period indicated that surgical wartime related articles were published more dynamically than the overall Croatian biomedical output (measured by the number of published articles that were indexed in the Medline database). Similar pattern was seen after the war, when non-war articles in the post-war period also seem to exhibit an increasing trend, which was even stronger after adjustment to the overall Croatian biomedical scientific output indexed in Medline database. The finding of increased post-war output of non-war related articles might be related to the wartime exposure, during which surgeons might have professionally benefited from increased workloads and exposure to the wartime conditions. These results support the idea that the warfare has a central place in the development of surgical profession[8–10]. An interesting advantage in line of this idea could be to perform a study which would compare different cohorts of surgeons, ie. those who were exposed to warfare and those who were not, and then compare their scientific output. However, yet another problem that would be present in such a study would be a cohort effect, reflecting in the increased chances that younger physician-scientists are more productive then their mentors, what was reported in some groups of the youngest research trainees or junior researchers[23–25]. This effect is even more strongly observed in the number of published indexed articles[22], showing that it is becoming increasingly easier to publish a paper, given that the number of indexed journals and corresponding papers is increasing over time. This means that any sequential analysis of publication output in one country that is done over a longer period of time (ten years or more) should take this into account. Two possible approaches include the use of trend analysis and calculation of adjusted rates. The main advantage of the first approach (trend analysis) is the possibility to infer and possibly even project trends and adjust to various other trends (such as the total number of publications in a country or in the entire indexing source). The second approach, the use of adjusted rates is based on rates that are adjusted for the overall increase in the number of published articles. Methodological approach that does not use this adjustment (and uses just a »crude«, un adjusted publication rates) is therefore overestimating the net increase in the publication output, and provides biased estimates.

Basic limitation of this study includes possible problems in identifying published articles and application of inclusion and exclusion criteria which could have modified the results. Furthermore, this study suffers from a number of potential confounding effects which could have affected the results, which is one of the substantial problems in estimation of aggregated publication analysis. Additionally, we did not intend to infer a causality link between war and the scientific output, which would require complying with much more conditions. Next, this study was based only on the number of surgical articles, without analysis of the scientific content or other publication details which might reveal additional information. Finally, a detailed cross-country comparison should be made in order to provide a more definitive and precise information on the general pattern of the warfare effects on biomedical publication output.

Nevertheless, this study indicates that despite the stagnation and decrease in the overall scientific output during wartime, surgical scientific output may show increasing trend in the wartime and early post-war conditions. A number of factors in each country and every situation can modify the productivity pattern during the war, thus making it very difficult to make generalized conclusions. The increased output in years after the war might be related to the warfare exposure, indicating that surgeons in Croatia might have scientifically benefited from the exposure to warfare.

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ZNANSTVENA PRODUKTIVNOST U KIRURGIJI I RAT U HRVATSKOJ 1991.–1995.

S A Ž E T A K

Cilj rada bio je istražiti znanstvenu produktivnost u kirurgiji u svezi s ratom od 1991.–1995. godine, na temelju objavljenih radova koji su indeksirani u bibliografskoj bazi podataka Medline tijekom 1980.–2005. godine. Podaci su analizirani korištenjem statističkih testova za analizu trenda, što je primjereniji pristup od izračunavanja stopa. Rezultati ukazuju na sporadično objavljivanje radova prije početka rata, koje je gotovo potpuno zaustavljeno na početku ratovanja. Tijekom ratnog razdoblja zabilježen je značajan uzlazni trend objavljivanja znanstvenih članaka vezanih uz ratnu tematiku (p=0,003). Tijekom razdoblja nakon završetka rata zabilježen je značajan uzlazni trend objavljivanja radova čija tematika nije bila povezana s ratom (p=0,027). Oba trenda bila su statistički značajno različita i od cjelokupne znanstvene produktivnosti u Medline-u vezane uz Hrvatsku, ukazujući na dinamičnije objavljivanje radova u kirurgiji u usporedbi s drugim područjima medicine. Rezultati ukazuju na to da je rat imao snažan utjecaj na znanstvenu produktivnost u kirurgiji.