



Article

The uterine fibroid/myoma tumour: analysis of the global research architecture using density-equalizing mapping

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KEY MESSAGE

This study represents the first global description of the uterine fibroid research landscape over the past century. The multitude of quantitative and semi-qualitative dimensions that were presently assessed demonstrates that this field of OB/GYN clearly differs from other fields and is closely related to surgical and diagnostic issues.

ABSTRACT

Uterine fibroids can severely impact a woman's quality of life, result in significant morbidity and are a leading indication for hysterectomy. Many aspects of the disease remain largely obscure. Despite these knowledge gaps, no detailed maps of the global fibroid research architecture have yet been generated. This study used the NewQIS approach to assess worldwide research productivity, encompassing numerous aspects of the scientific output, quality and socioeconomic features. Regression analysis indicated an increase in fibroid research activity in the investigated time periods. Global research output was dominated by leading Western countries, with the USA at the forefront, but also by East Asian countries. Socioeconomic benchmarking revealed that Taiwan had the highest fibroid research activity per GDP, with a calculated average of 279.46 fibroid-related publications per 1000 billion USD GDP. Finland was the most active country with respect to research activity per population size. Subject area analyses revealed major differences in research focuses, for example 'Radiology, Nuclear Medicine and Medical Imaging' was assigned to 29.92% of South Korean and to only 10.38% of US-American publications. In conclusion, this analysis of global fibroid research activity illustrates a multitude of important features ranging from quantitative and semi-qualitative fibroid research aspects to socioeconomic benchmarking.

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Introduction

Uterine fibroids or leiomyomas represent the most common benign tumour of the female genital tract [Downes et al., 2010; Lumsden et al., 2015; Sparic et al., 2016]. Matthew Baille first described these monoclonal tumours originating from uterine myometrium, in 1793 [Sparic et al., 2016]. A woman over 45 years of age has a fibroid lifetime risk of more than 60% as estimated in longitudinal studies [Okolo, 2008]. However, the accurate prevalence of fibroids is largely unknown because the majority remain asymptomatic and undiagnosed. In a population-based study conducted in the USA, 51% of randomly selected premenopausal women with no previous history of myomas received an ultrasound-based diagnosis of uterine fibroids [Baird et al., 2003]. The incidence of leiomyomas is up to three-fold greater in black women, who develop these tumours at earlier ages than white females [Baird et al., 2003]. Uterine fibroids become clinically apparent in only up to 40% of women aged 40 years and over [Okolo, 2008]. Also, their incidence based on histology is more than twice the clinical incidence [Okolo, 2008; Sparic et al., 2016]. Leiomyomas cause significant morbidity due to abnormal uterine bleeding and pelvic pressure symptoms. Hence, they have great impact on the quality of life of many women and the healthcare system in general [Okolo, 2008; Sparic et al., 2016].

Recently published reviews concluded that more research is necessary to determine the risk factors associated with fibroid onset and growth [Commandeur et al., 2015; Drayer and Catherino, 2015]. Also, no clear insight into uterine fibroid epidemiology has yet been achieved. Future research into the genetic background and modifiable risk factors may shed light on fibroid prevention and provide new approaches to non-surgical and surgical fibroid treatment [Sparic et al., 2016; Yang et al., 2016]. It is for these reasons, as well as the high myoma prevalence, that further multidisciplinary, translational and clinical research is needed. To plan new research strategies and to supply decision-makers with information concerning funding strategies, scientometric approaches may be of help for uterine fibroid research. It is therefore the objective of the present study to assess scientific performance in the field of uterine fibroid research over the past century using the tools of the 'New Quality and Quantity Indices in Science' (NewQIS) platform [Groneberg-Kloft et al., 2009a, 2009b]. The project combines scientometric tools and advanced density-equalizing mapping procedures [Gastner and Newman, 2004] to assess the global uterine fibroid research architecture.

Materials and methods

NewQIS protocol

The present study was facilitated by the NewQIS platform [Groneberg-Kloft et al., 2009a, 2009b]. We established this computing platform in 2009 as an international, multidisciplinary project, and it has been used to assess more than 50 different biomedical entities to date. The NewQIS platform approach encompasses advanced visualization algorithms such as Gastner and Newman's density-equalizing calculations, indices modified for country-specific contributions to the current body of literature based on the concept of the Hirsch index (h-index) [Hirsch, 2005, 2007] and other scientometric tools in order to evaluate and visualize uterine

fibroid-specific research activity [Groneberg-Kloft et al., 2013; Kusma et al., 2009; Vitzthum et al., 2010].

Data source and search algorithms

The Web of Science database (WoS, Thomson Scientific) was employed for data collection as described in previous NewQIS studies [Gerber et al., 2014; Koster et al., 2016]. The following search strategy was used to identify fibroid-related research data: fibroid* OR fibroma* OR fibromyoma* OR leiomyoma* OR myoma* [Title] and uteri* OR uterus OR myometr* OR myomectom* OR hysterectomy OR GnRH OR emboli*ation OR *fertil* OR reproduct* OR pregnan* OR abort* OR miscarriage* OR pelvi* OR gynecolog* OR obstetric* OR menorrhagia OR bleeding OR anemia OR oestrogen OR steroid* OR *menopaus* OR black OR afroamerica* OR nullipar* OR submucous OR intramural OR subsero* OR intracavitar* OR cervi* [Topic] NOT cutan* OR skin OR *esophag* OR gastr* OR gallbladder OR liver OR spine [Title] NOT 'gastrointestinal bleed*' OR 'GI bleed*' OR 'rectal bleed*' OR 'vaginal leiomyoma*' OR *nasal OR *vascular leiomyoma*' OR 'jejunal leiomyoma*' OR 'duodenal leiomyoma*' OR 'leiomyoma* of the duodenum' OR 'leiomyoma* of the jejunum' OR appendiceal leiomyoma OR 'intestinal leiomyoma*' OR 'Leiomyoma* of the urinary bladder' OR 'bladder leiomyoma*' OR urethral leiomyoma OR 'cardi* leiomyoma*' OR 'cardi* fibroma*' OR chondromyxoid OR fibromatosis OR 'leiomyoma of the breast' OR 'skin leiomyoma*' OR *esophag* leiomyoma* OR 'gastr* leiomyoma*' OR 'colon* leiomyoma*' OR 'benign metastasizing leiomyoma*' OR 'mesosalphinx leiomyoma*' OR 'fibroma* of the jaw*' OR odontogenic OR 'Collagenous Fibroma*' OR 'Nuchal Fibroma*' OR 'leiomyoma of the vulva' OR 'soft tissue leiomyoma' OR male OR 'black bear' OR 'Colon* Polyp' OR 'endocardial fibroma*' OR *pharyngeal fibroma*' OR 'ventricular fibroma' OR 'pulmonary emboli*ation' OR 'ovar* leiomyoma*' OR 'ovar* fibroma*' OR bone [Topic].

The search covered the time period between 1900 and 2015. This search term was entered in the WoS as described previously for other areas of medicine [Groneberg et al., 2016; Quarcoo et al., 2015; Scutaru et al., 2010]. All document types were included in the analysis.

Data analysis and categorization

As previously described, retrieval of the metadata with exact bibliographic details of all uterine fibroid-related publications was followed by numerous sorting and analysing steps [Groneberg et al., 2015; Ohlendorf et al., 2015; Scutaru et al., 2010]. These steps included analysis for originating countries, languages, document types, citations, cited references, year published and subject categories. Then, amongst other things, research-specific, country-specific h-indices were constructed. The h-index was developed by Jorge Hirsch in 2005 in order to gauge the quality attributed to the scientific achievement of single authors [Hirsch, 2005, 2007]. The concept was used here particularly to assess country-specific uterine fibroid research, as described previously for other diseases [Groneberg-Kloft et al., 2009a, 2009b; Hirsch, 2005].

Economic analysis

In order to assess the relative contributions of highly active nations in uterine fibroid research with regard to their socioeconomic status and financial resources, the national gross domestic product (GDP)

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