



## ADIPOBIOLOGY: A SCIENTOMETRIC VIEW TO ITS INCREASING SIGNIFICANCE

**Dimitar T. Tomov**

*Department of Health Economics and Management, Faculty of Public Health, Medical University of Varna, Bulgaria*

*Recent seminal papers in adipose tissue launched a new integrating discipline designated “adipobiology”. Here we provide a retrospective problem-oriented search in MEDLINE and EMBASE databases available through OVID in 1980-2005; available papers published in 2006/2007 were also pursued. The following terms were used as key words during the information retrieval: adipose tissue, adipokine(s), adipocytokine(s), adipisin, adiponectin, and leptin. Although these adipocentric publications are easy to find in Internet browsers worldwide, we detected the term of “adipobiology” in a couple of biomedical databases only. Obviously, much remains to be done in order to attract the efforts of a rapidly increasing scientific community to the establishment and successful institutionalization of this discipline facing the requirements of knowledge-based, information-driven society of the new millennium. From a scientometric point of view, the present Dance Round describes some aspects of the dynamic growth of the world publication output in basic, translational and clinical adipobiology as compared with some other recently emerged topics, and traces some elements of its future development. **Biomed Rev 2006; 17: 111-116.***

**Key words:** adipose tissue, adipobiology paradigm, historiography of science, scientometric approach

### INTRODUCTION

The most momentous changes that occurred in studying biology of adipose tissue have been the discovery of leptin, an adipocyte-secreted protein, at the end of 1994 as published by Friedman’s research group in *Nature* (1994; 372: 425-432). This triggered the publication of a large number of papers

demonstrating that the simple paradigm of adipose tissue as merely a fat store has evolved into a multiplex paradigm of this tissue as potent endocrine and paracrine organ (see below).

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Correspondence and reprint request to Dr Dimitar Tomov, Department of Health Economics and Management, Faculty of Public Health, Prof. Paraskev Stoyanov Medical University of Varna, BG-9002 Varna, Bulgaria. Tel.: 359 52 322 425  
Fax: 359 52 650 019, E-mail: dimtomov@yahoo.com

pursued. The following essential terms were used as key words during the information retrieval: adipose tissue, adipokine(s), adipocytokine(s), adipisin, adiponectin, and leptin. Under the term of ‘adipobiology’ only 11 papers had been abstracted during this period. Note that another term targeting adipose tissue research, that is, “adiposcience” has been introduced in 1996 by Japanese scientists (George Chaldakov, Medical University, Varna, Bulgaria; personal communication); however, it “does not like to be upregulated”, at least, in our PubMed search.

The bibliographic descriptions of all the relevant publications devoted immediately, to a greater or smaller extent, to different aspects of this complex interdisciplinary field were retrieved and processed. The quantitative characteristics of the following main bibliometric parameters were rendered an account (1): (i) number of abstracts of publications, (ii) types of primary publications, (iii) number, titles and thematic belonging of the journals containing the primary publications, (iv) countries of journals and of authors, (v) number of authors per publication and number of unique authors as a whole, and (vi) types and nominations of scientific institutions.

The semantic analysis and the statistical processing of these secondary information sources resulted in several specific scientometric distributions. A small amount of the data illustrates the capacities of this complex methodology to follow-up the progress of this socially significant research topic.

The purpose of the present *Dance Round* is to demonstrate some aspects of the dynamic growth of the world publication output in basic, transitional and clinical adipobiology as compared with some other recently emerged topics and to trace some elements of its future development from a scientometric point of view.

### ADIPOBIOLOGY JUXTAPOSED TO OTHER BIOMEDICAL HOT TOPICS

We summarized some interesting data in Tables 1 through 7 to demonstrate a particular similarity between adipobiology and the other research topics having already gained a real social recognition such as ‘AIDS/HIV’, ‘*Helicobacter (Campylobacter) pylori*’, ‘nanotechnology/nanotechnologies’, ‘nuclear magnetic resonance/magnetic resonance imaging’ (NMR/MRI), ‘learning and memory’ (2) as well as ‘memory and cognition’ (3). That is a sharp increase of the number of publications appears in a specific year followed by its dramatic growth in subsequent years.

**Table 1.** Dynamics of world publication output on several adipobiology topics as reflected in EMBASE and MEDLINE through OVID in 1980-2005.

Year of publication	EMBASE	MEDLINE
1980-1990	92	125
1980	3	1
1985	11	17
1990	20	24
1991	20	21
1992	16	19
1993	17	21
1994	17	18
1995	36	71
1996	220	293
1997	584	575
1998	753	775
1999	902	932
2000	943	1114
2001	1135	1260
2002	1338	1367
2003	1606	1584
2004	1835	1758
2005	2150	1953
<b>Total</b>	<b>11660</b>	<b>11886</b>

**Table 2.** Comparison between MEDLINE through OVID and MEDLINE through PubMed concerning world publication output on these topics in 1980-2006

Year of publication/ Papers	MEDLINE through OVID	MEDLINE through PubMed
01.01.1966-31.07.2006	12705	13335
1980-2005	11886	11960
1991-2005	11761	11746
1980-1990	125	214
2000	1114	1059
2001	1260	1198
2002	1367	1410
2003	1584	1590
2004	1758	1808
2005	1953	2096

**Table 3.** Publication patterns of these topics as reflected in EMBASE and MEDLINE in 1980-1990

Scientometric parameters	EMBASE	MEDLINE
Number of journals	40	47
Number of countries of journals	8	8
Number of countries of authors	15	16
Number of unique authors	223	263
Number of authors with one paper only	174	186
Number of authors with two papers	29	35
Number of authors with three papers	12	17
Number of authors with four papers	5	10
Number of authors with five papers	-	7
Number of authors with six papers	-	6
Number of authors with eight papers	3	-
Number of authors with 13 papers	-	1
Number of authors with 14 papers	-	1
Number of papers with one author only	7	9
Number of papers with two authors	22	34
Number of papers with three authors	38	21
Number of papers with >4 authors	25	33

**Note:** During this period, in *Excerpta Medica* and in its electronic version *EMBASE*, respectively, only the names of the first three authors of the abstracts of papers authored by more than 4 authors were listed. That is why in *EMBASE* the total number of unique authors is relatively smaller and two most productive authors presented with 8 papers only while in *MEDLINE* they did with 13 and 14 papers, respectively.

**Table 5.** Dynamics of world publication output on NMR and/or MRI as reflected in MEDLINE through PubMed in 1956-2006

Year span (single year)/papers	n
1956-1963	49
1964	143
1965	210
1966	396
1967	528
1968	702
1969	892
1970	914
1971	1025
1972-1976	6982
1977-1981	6173
1982-1986	12830
1987-1991	31525
1992-1996	52857
1997-2001	75137
2002-2006	105752
2005	24034
<b>Total</b>	<b>296115</b>

**Table 4.** Dynamics of world publication output on some rapidly advancing research fields as reflected in MEDLINE through PubMed until the end of 2006

Topic	Papers - total	Initial year/papers	Papers in 1986-1990	Papers in 1991-1995	Papers in 1996-2000	Papers in 2001-2005	Papers in 2006
AIDS/HIV	106159	1982 - 27 papers	25387	29194	22479	21807	3674
<i>Helicobacter (Campylobacter) pylori</i>	23112	1987 - 1 paper	296	3717	7918	9544	1637
Nanotechnology/ies	7817	1991 - 2 papers	-	19	85	5804	1909

**Table 6.** Dynamics of world publication output on 'memory and learning' in PsycLit in 1884-1973

Year span (single year)/papers	n
1884-1900	5
1901-1910	26
1911-1920	51
1913 only	6
1921-1925	60
1926-1930	201
1931-1935	358
1933 only	97
1936-1940	254
1941-1945	167
1946-1950	898
1951-1955	1833
1953 only	372
1956-1960	2602
1961-1965	325
1966-1970	1257
1971-1973	1111
1973 only	417
<b>Total</b>	<b>9148</b>

**Table 7.** Dynamics of world publication output on 'memory and cognition' in MEDLINE through PubMed in 1965-2004

Year span/papers	n
1965-1970	169
1971-1975	373
1976-1980	458
1981-1985	1008
1986-1990	1858
1991-1995	3324
1996-2000	5844
2001-2004	7712
<b>Total</b>	<b>20746</b>

According to our own concept about the unity of the interdisciplinarity, institutionalization and internationalization of science and university education (4,5), these essential elements of the contemporary scientific enterprise are being mutually connected to a gradually increasing extent and, therefore, should be comprehensively analyzed in common. Making effective use of computerized scientometric tools for historiographic purposes (2,3,6,7) enables both experienced researchers and enthusiastic beginners to timely define the truly promising aspects of a new topic when planning and implementing an interdisciplinary, international and sufficiently institutionalized collaboration thus meeting the requirements of science humanization (8,9).

We emphasize that user's access to different biomedical databases depends on several factors such as PC and Internet infrastructure, specific narrow scientific and foreign language competence, information culture as well as technological equipment for effective problem-oriented research. Fortunately, the differences concerning the information retrieval capacities of PubMed, the Internet version of *MEDLINE* that is free-of-charge since the recent decades onwards, on the one hand, and its OVID or EBSCO versions as well as *EMBASE* accessible through OVID, on the other hand, are not substantial, although the last two databases require a regular subscription payment by university libraries.

We will briefly comment of certain additional aspects of our analysis.

In 1980-1990, the number of journal profiles gradually augments and includes a variety of biomedical, clinical, chemical and physical disciplines along with various interdisciplinary fields. These profiles include cell biology, cell physiology, neurobiology, neurochemistry, neuroendocrinology, neuroanatomy, cellular biochemistry, biochemistry and physiology as well as some specific scientific terms such as hormones, lipids, peptides, brain, liquid chromatography, etc. Later on, in 2005, a series of promising, narrow-topic journals have occurred on the world information market such as *Cell Metabolism* (USA), *Surgery for Obesity and Related Diseases* (USA), etc. Some problem-specific journal-title words should be listed such as digestology, lipidology, eating and weight disorders, cell cycle, cytokine, stem cells and development, obesity, etc.

Similarly to most scientometric figures, the USA science

occupies a dominant position in any aspects of the publication output in this field. However, the involvement of some other actors such as the UK, Germany, France, Italy, Japan, Canada, Sweden, the Netherlands, Bulgaria, Czech Republic, Hungary, Russia, and Poland should also be emphasized. Therefore, science stratification in studying adipose tissue biology, that is, today's adipobiology (10-15), has emerged in the 1980's and continues until present.

The number of international journals containing in their titles the terms of 'European', 'International' or 'World' and of their thematic belonging gradually increases. Already in the initial period, the '*International Journal of Peptides and Protein Research*' contained 4 abstracted papers on these topics in MEDLINE and 5 ones - in EMBASE. Besides, there was an abstracted paper from the '*European Journal of Biochemistry*' in MEDLINE.

Another feature of internationalization of modern interdisciplinary science is the permanently rising relative share of publications in foreign journals. According to EMBASE data files in 1980-1990, the authors from 7 countries have published 37 papers in their own national journals while those from 14 countries have published 55 papers in foreign journals. Authors from the Netherlands have published 9 papers in foreign journals from 3 countries only while those from Canada - 7 papers in journals from 4 countries. The authors from the USA have published 13 papers in foreign journals and 28 ones - in American journals. The relative share of foreign journal publications by the authors from the other 14 countries is very high - 79%.

The diversification of the nominations of author's affiliations deserves a special attention by scientists from smaller countries. For instance, addresses of research institutions which scholars have occupied a leading position among the members of the world scientific community in the field of adipobiology: Department of Metabolic Medicine, Graduate School of Medicine, Osaka University, Osaka, Japan; Sumitomo Hospital, Osaka, Japan; Neuroendocrine and Obesity Biology Unit, Liverpool Centre for Nutritional Genomics, Liverpool, UK; Department of Molecular Sciences, College of Medicine, University of Tennessee Health Science Center, Memphis, Tennessee, USA; Division of Energy Balance and Obesity, Aberdeen, UK; Department of Internal Medicine III, University of Leipzig, Leipzig, Germany; Unit on Growth and Obesity, Bethesda, MD, USA; Obesity Research Unit, Toulouse, France; Department of Biological Sciences,

The Open University, Milton Keynes, UK; Obesity Research Center, New York, NY, USA; Division of Cell Biology, Medical University, Varna, Bulgaria; Institute of Neurobiology and Molecular Medicine, NGF Section, CNR-European Brain Research Institute, Rome, Italy.

Several recent papers convincingly prove the necessity of united efforts by scientists from different disciplines aiming at further delineating of the specific and complex subject of adipobiology and its interrelations with a variety of sciences and disciplines thus creating the paradigm necessary for its institutionalization. These papers are published in (i) the Adipobiology of Disease topic issue of *Immunology Endocrine and Metabolic Agents in Medicinal Chemistry*, volume 7 (2), 2007, (ii) Fantuzzi G, Mazzone T, editors. *Health and Nutrition. Adipose Tissue and Adipokines in Health and Disease*. Humana Press Inc., Totowa, NJ, USA, 2006, (iii) Ralf Paus' Controversies in Experimental Dermatology entitled "What are subcutaneous adipocytes really good for...?" published in *Exp Dermatol* 2007;16: 45-76), and (iv) the present volume of *Biomedical Reviews*.

## CONCLUSION

Our results demonstrate the role of the computer-aided scientometric approach for the improvement of science policy management in small countries. These rich sources of information could be used for this promising and important research field, as adipobiology. They should be provided to young researchers and university faculty in order to promote their efforts for meeting the increasing social and biomedical requirements of today and the future. In effect, adipobiology will be associated with adipopharmacology (16-18), nutrigenomics (19) and other related research fields. The future of adipobiology research comprises a much more intensive differentiation and integration of the problem circles, of propagation of ideas and methods into problem-oriented, mono-, two-, multi- and interdisciplinary branches of the holistic knowledge of purposeful promotion of human health and effective prediction and prevention of disease as well as a paradigm of science globalization.

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