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Irja Laamanen, Mikko Härmä, Eira Viikari-Juntura, Kirsti Husgafvel-Pursiainen

Bibliometric analysis

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1. Introduction

Bibliometric analysis can serve as an indicator of scientific productivity reflecting the amount, quality and networking of the scientific publications. As part of the international evaluation of the Finnish Institute of Occupational Health (FIOH), this bibliometric analysis assesses the scientific publication productivity of the Institute. The analysis of the publication activity of the Institute is based on (i) its own publication database (referred to with the acronym TAVI), (ii) the Web of Science, and (iii) Scopus databases. The latter two represent international databases, which provide access to bibliographic information. SCOPUS (Elsevier) contain information on more than 16 000 peer-reviewed journals. The Web of Science (Thompson Reuters) contains three citation databases - Science Citation Index (SCI) Social Sciences Citation Index (SSCI) and the Arts & Humanities Citation Index (A&HCI) - and over 10 000 multidisciplinary high-impact journals.

In addition, the analysis contains a review of the publication activity of the researchers of FIOH in some of the central occupational health and safety (OH&S) scientific journals.

The general aim of this report is to analyse the publication activity of FIOH during the years 2004 through 2008 assessed in relation to:

- publication category,
- time period,
- major OH&S topic areas,
- other major national OH&S research institutes, and
- researcher networking.

The methods used in the bibliometric analysis are described in detail in Appendix 1.

2. Results

2.1. Publication activity in 2004-2008

Based on the publication files annually collected at FIOH, 5 639 publications were listed in 2004-2008. 60 % of all the publications were scientific articles, such as original articles, reviews and other scientific reporting (Figure 1). 40 % of FIOH publications were popular articles for the general audience and other non-scientific publications.

Table 1 shows the overall trend in the scientific production from 2004 to 2008, based on FIOH's own publication database (TAVI). Table 2 shows the records found from the Web of Science and Scopus. The numbers of publications differ between the databases to some extent. The variation of numbers of publications in each of the databases is caused mainly by differences in the coverage of journals and how up-to-date the databases are. There is an overall decreasing trend in scientific publication by FIOH

researchers during the reference period up to 2007. In 2008, the number of publications increased in TAVI and SCOPUS, but not so far (21st Jan) in Web of Science. The Web of Science and Scopus records indicate a fluctuating decrease of annual number of international scientific publications during the last five years. As a more specific feature, the number of journal articles has decreased in national peer review journals in Finland.

Figure 1. The distribution of FIOH publications in 2004-2008.

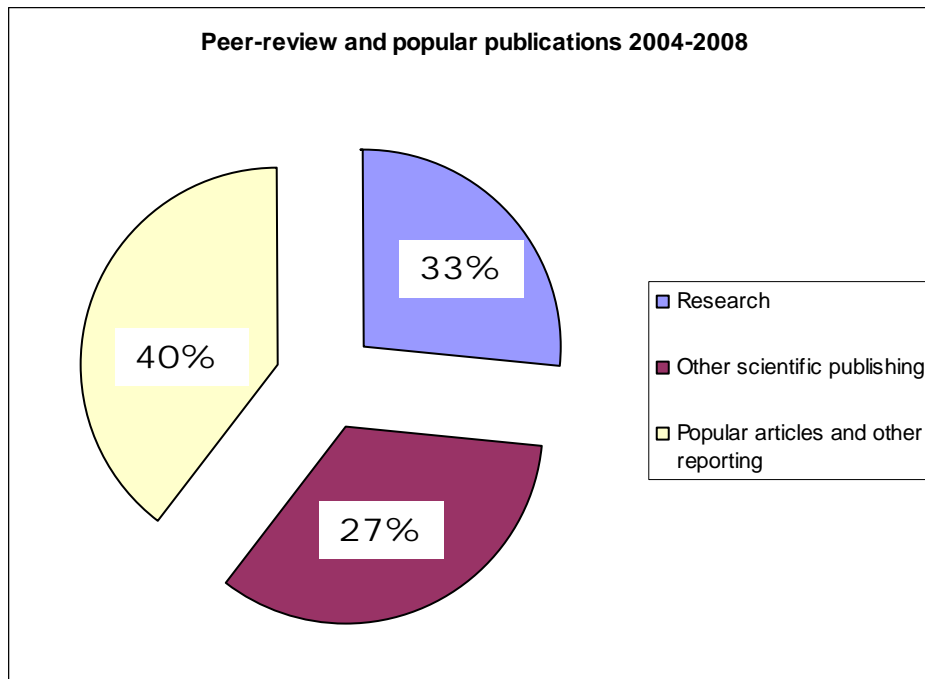


Table 1. Publication productivity of FIOH researchers in 2004-2008 (Jan16th 2009).

	2004	2005	2006	2007	2008	All
Papers in international peer review journals ¹	261	220	265	227	278	1251
Papers in national peer review journals in Finland ¹	77	38	37	49	34	235
Other scientific publishing. int./domestic ¹	106/ 292	164/ 190	126/ 316	121/ 265	76/ 229	1885
Popular articles and other reporting, int./domestic ¹	2/ 449	14/ 517	13/ 473	16/ 417	15/ 352	2268
Total	1187	1143	1230	1095	984	5639
Annual researcher years based on FIOH follow-up	227	210	264	267	253	1221
Scientific papers per researcher year ¹	1,5	1,2	1,1	1,0	1,2	
Other scientific publ. per researcher year	1,8	1,7	1,7	1,5	1,2	
Popular articles and other reporting per researcher year	2,0	2,5	1,8	1,6	1,5	
All publishing per researcher year	5,3	5,4	4,6	4,1	3,9	

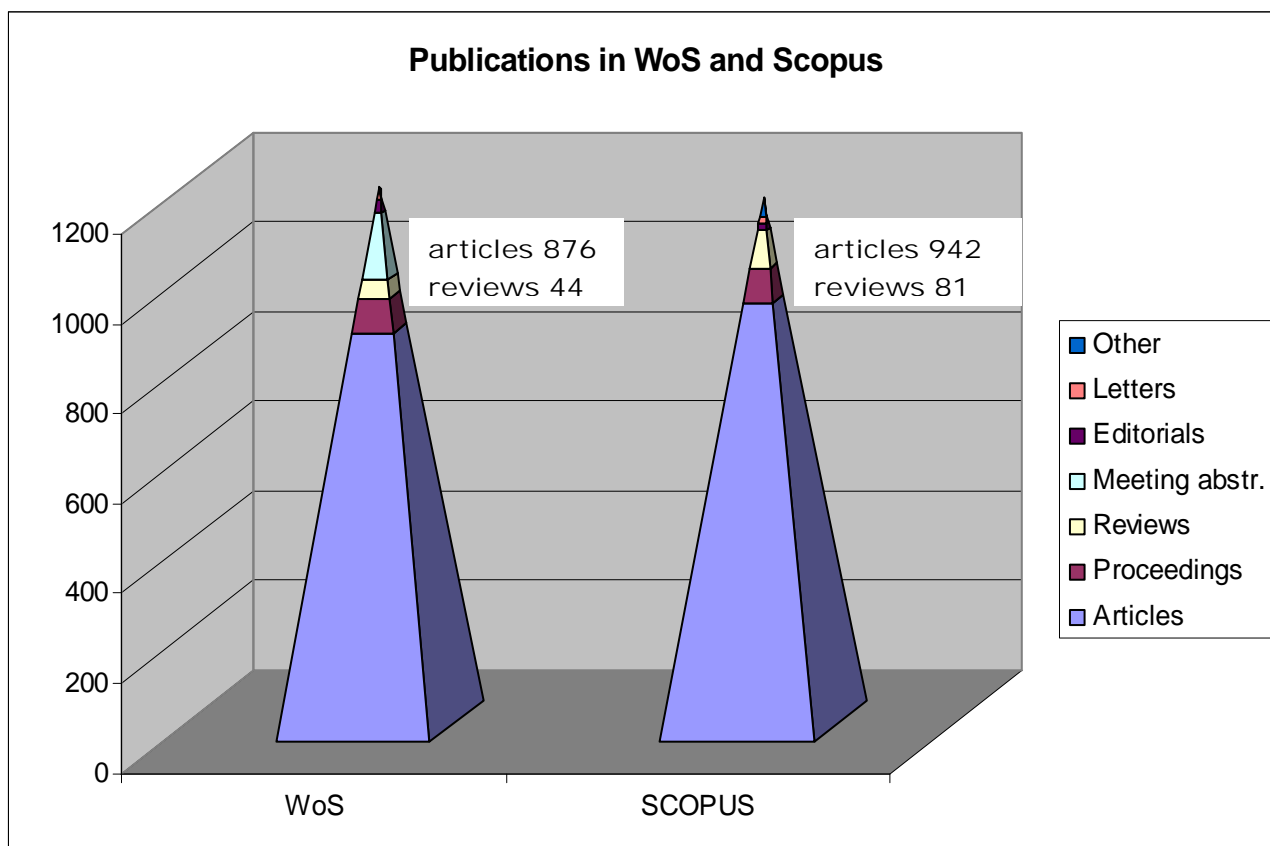
¹ Numbers obtained from the TAVI refers to publication database of the Finnish Institute of Occupational Health (FIOH)

Table 2. Publications in the Web of Science and SCOPUS (Jan 16th 2009)

	2004	2005	2006	2007	2008	All
Papers covered in the Web of Science						
All articles	245	208	261	247	232	1 193
* original articles	169	164	196	185	162	876
* reviews	10	5	9	6	14	44
* proceedings	12	15	15	5	26	73
* other (editorials, letters etc)	54	24	41	51	30	200
Papers covered in SCOPUS						
All articles	221	214	249	232	250	1 166

Table 2 and Figure 2 show the FIOH publications by publication categories as in the Web of Science (WoS) and SCOPUS. The majority of the scientific publications in these two databases were original scientific articles.

Figure 2. Summary of all publications produced by FIOH researchers in 2004-2008 as in WoS and SCOPUS (Jan 15th 2009)



Based on FIOH's publication database (TAVI), the international peer-reviewed research articles in 2004-2007 (in total, n= 973) and 110 domestic peer review

journals (e.g. Duodecim, Finnish Medical Journal, People and Work) were divided into the following topic categories:

Topic category of publications	International	Domestic
Occupational health	51%	36%
Work environment	33%	14%
Work organization	16%	51%

It should be noted, however, that many papers relate to several topic areas simultaneously. For example, a large number of FIOH publications have addressed the occupational health problems due to work organization.

Most scientific articles published by FIOH researchers were co-authored with researchers from other research organizations. In about 50% of the articles, the first author was from FIOH.

2.2. Publication activity 1986-2008

As a brief view into FIOH's publication history, altogether 3 888 publication records by FIOH were found from WoS for the years 1986-2008 (Figure 3) (by Jan 9th 2009). The publications include original articles, reviews, proceedings, meeting abstracts, and other document types, thus showing the institute's whole range of scholarly communication.

The number of FIOH publications increased steadily from 1993 to 2004. However, for the period of 2006-2008, the number of FIOH publications in WoS has decreased to some extent. At the same time, the number of annual citations to FIOH publications has grown in increasing steps (Figure 4). 53 articles have received 100 or more citations; this can be regarded as an excellent result.

Figure 3. FIOH scientific publications in 1986-2008 according to the Web of Science (Jan 9th 2009)

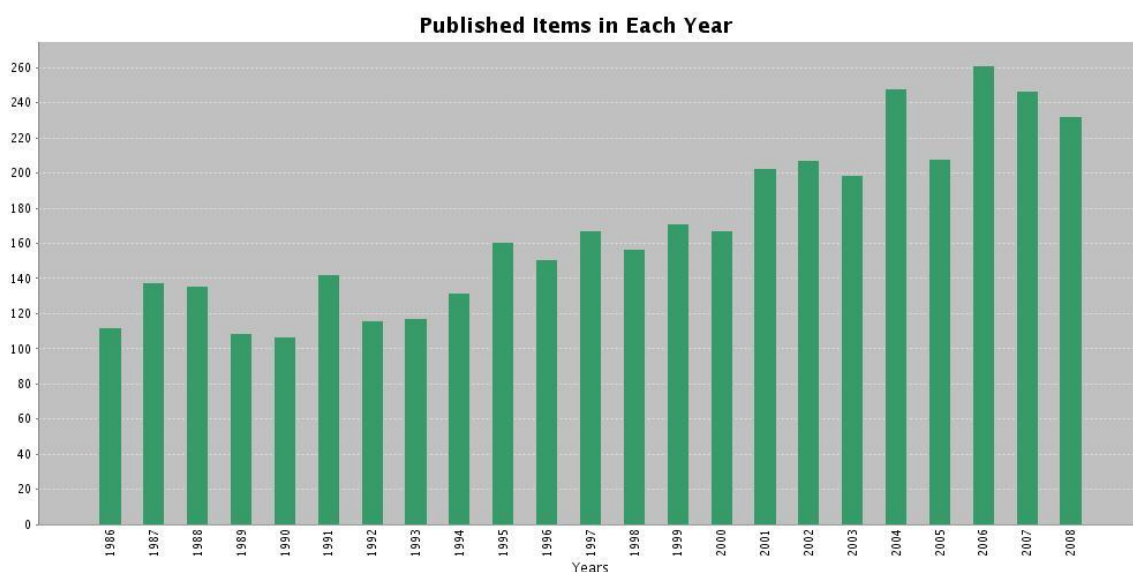


Figure 4. Cumulative citations to the FIOH publications in 1990-2008

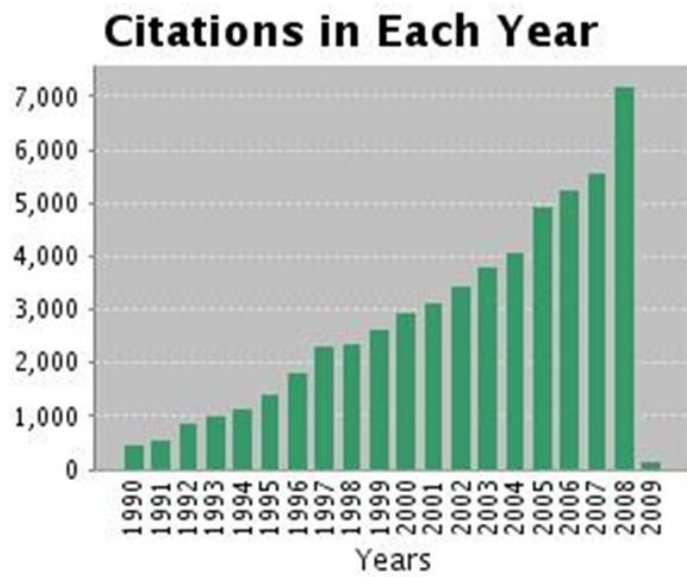


Table 3. Cumulative citations and h-index of FIOH publications 1990-2008.

FIOH publications	1990-2008
Number of articles	3 388
Citations with self-citations	55 903
Average citations per item	14,38
h-index ¹	81
Citations without self-citations	32 842
Self- citation number	23 061
Self-citation %	41,3%

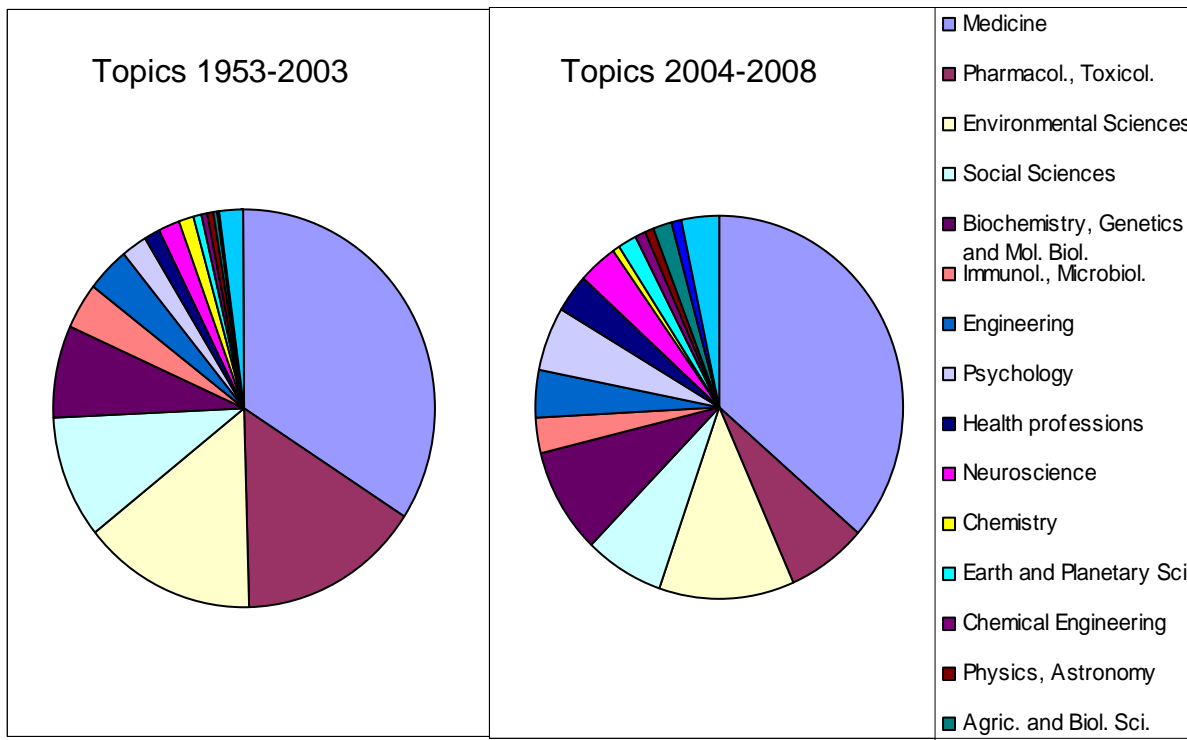
¹ h-index refers to the scientific productivity and the apparent scientific impact of a scientist.

In Table 3, the h-index shows that FIOH has produced 81 papers that had each received at least 81 citations.

2.3. Main publication topics: cumulative and for the years 2004-2008

In total, 4 281 FIOH publications were identified in SCOPUS for the years 1953 to 2003, before the institute's new strategy period. For the period 2004 to 2008, including the first 3 years of the new strategy, 1 166 publications were identified (Figure 5). Due to the multi-disciplinary nature of FIOH research activities, classification by scientific areas is not an easy task and does not necessarily give unambiguous results. However, some trends can be identified. In comparison to earlier years, the volume of publishing on the following areas has increased during 2004-2008: biochemistry, genetics and molecular biology, psychology, health professions and neuroscience. In contrast, there is a decreasing trend visible in publications in the areas of pharmacology and toxicology, environmental sciences, social sciences, and chemistry.

Figure 5. Scientific areas of FIOH publications during 1958 - 2003 and 2004 -2008. (15.1.2009)



2.4. Citation and productivity analysis

The aim of this analysis was to use the distribution of citations to articles and the level of non-citation as measures of the quality of FIOH articles. Table 4 shows the numbers of citations to the FIOH articles during the two 2-year periods, 2004-2005 and 2006-2007. On the average, FIOH papers have received 8.6 citations per article in 2004-2005 and 3.7 in 2006-2007 (Jan 9th 2009). It is evident that the level of citations will grow and non-citations decrease. The second period naturally has a lower number of citations and higher number of non-citations than the first period.

Table 4 Citations to FIOH publications during 2004-2005 and 2006-2007

	2004-2005	2006-2007
Papers covered	437	472
Citations with self-citations	3 763	1 751
Citations without self-citations	3 055	1 385
Citations per paper (including self-citations)	8.61	3.71
Citations per paper (excluding self-citations)	6.99	2.93
Articles not cited (including self citations)	98	147
Percentage of articles not cited (including self-citations)	22%	31%

During 2004-2008, the highest numbers of citations were focused on the strategy-based top scientific areas of research: genetic research, immunotoxicology, psychosocial issues and health. Appendix 2 lists the most cited individual FIOH papers.

Table 5 ranks the 20 most productive FIOH authors in the reference period of 2004-2008. They were ranked according to the number of original articles and reviews found from WoS using a search that identified articles listing FIOH as an author's affiliation. This excluded papers without the Institute as the affiliation.

Prof. Mika Kivimäki was the most productive of all FIOH authors during the period, but also other scientists from the Unit of Excellence on Psychosocial issues, such as Prof. Jussi Vahtera, Dr. Marianna Virtanen and Dr. Jaana Pentti, were among the most productive authors. Several groups within the area of musculoskeletal disorders such as those of Prof. Hilikka Riihimäki, Dr. Päivi Leino-Arjas, Dr. Svetlana Solovieva, Prof. Jaro Karppinen, and Prof. Eira Viikari-Juntura, are on the ranking list of the most productive researchers, as well as the research group of Prof. Harri Alenius (Unit of Excellence on Immunotoxicology). Also, the groups within the area of genetic research, genotyping studies and genetic toxicology of Dr. Hirvonen, Prof. Husgafvel-Pursiainen and Dr. Norppa have been highly productive. Other productive researchers include Drs. Vehmas, Väänänen, Honkonen and Rintamäki.

Eight Cochrane reviews were published by the group lead by Dr. Jos Verbeek from the evidence-based OH&S strategic area of FIOH. The number of new reviews is remarkable, when compared to the contents of the Cochrane Library, where the total number of OH&S reviews is less than 50 records. Information on them could not be

found from WoS, but only from Scopus. This is another indication of how various databases give slightly different views regarding publishing activity.

Table 5. Publication activity of FIOH authors (2004-2008): number of publications for the 15 most productive authors.

Author	Centre of expertise, FIOH	WoS original article, reviews	WoS other articles	WoS h-index
Kivimäki, M.	Work organisations	134	14	16
Vahtera, J.	Work organisations	110	13	16
Virtanen, M.	Work organisations	55	5	9
Leino-Arjas, P.	Health and Work Ability	45	5	10
Pentti, J.	Work organisations	39	5	10
Karppinen, J.	Health and Work Ability	33	1	8
Alenius, H.	Health and Work Ability	32	25	9
Hirvonen, A.	Health and Work Ability	32	14	11
Kauppinen, T.	Good Practise and Competence	30	2	7
Riihimäki, H.	Health and Work Ability	30	2	9
Laitinen, J. (Jaana)	Health and Work Ability	28	0	10
Vehmas, T.	Health and Work Ability	28	2	5
Solovieva, S.	Health and Work Ability	23		6
Husgafvel- Pursiainen, K.	Health and Work Ability	21	7	7
Norppa, H.	Work Environment Development	21	14	12
Väänänen, A.	Work organisations	21	3	7
Honkonen, T.	Work organisations	20	3	6
Viikari-Juntura, E.	Health and Work Ability	20	3	5
Luukkonen, R.	Good Practise and Competence	19	6	6
Rintamäki, H.	Health and Work Ability	18	5	4

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2.5. FIOH publication productivity compared to other major OH&S institutes in Europe and the Unites States

To compare the publication activity of FIOH to other major OH&S institutes, the publication activity of the following institutes were mapped (personnel/scientists in parentheses):

European institutes:

- Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BauA), Germany (657/146)
- BGIA - Institut für Arbeitsschutz, Germany (240/60)
- The Health & Safety Laboratory (HSL), UK (390/?)
- l'Institut National de Recherche et de Sécurité (INRS), France (650/108)
- Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro (ISPESL), Italy (?/?)

- National Institute of Occupational Health (STAMI), Norway (115/28)
- National Research Centre for the Working Environment (NRCWE), Denmark (153/73)
- Nofer Institute of Occupational Medicine, Poland (439/87)

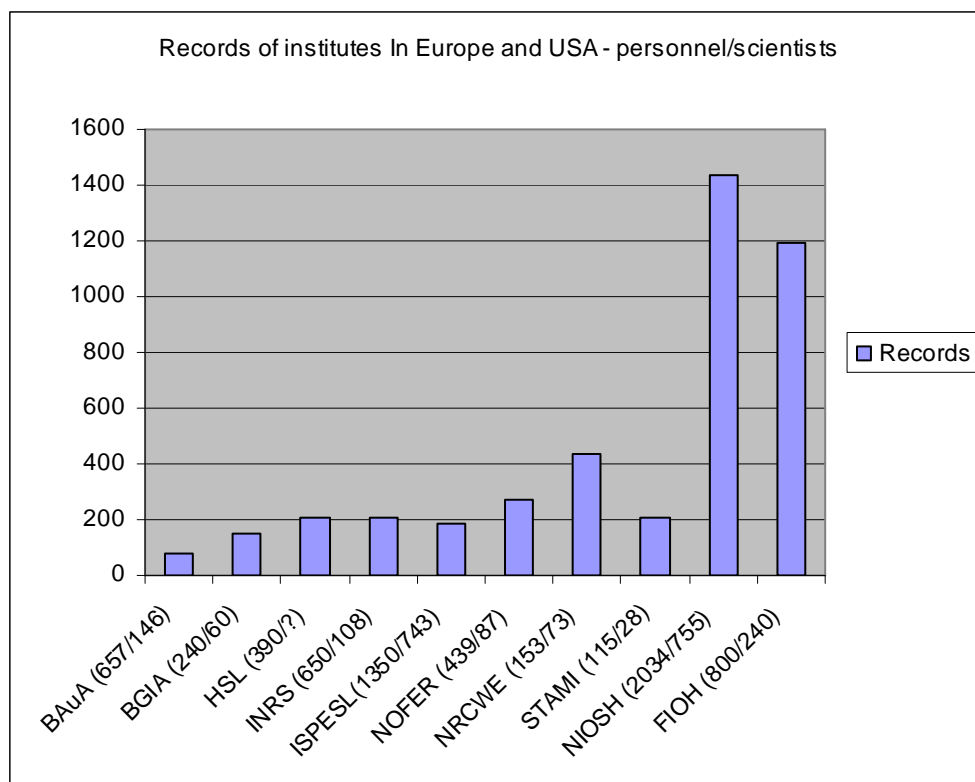
The United States:

- The National Institute of Occupational Health (NIOSH), USA (2034/755)

From the large European institutions, TNO was not included in the analysis due to its wide area of scientific research including large areas of interest in other fields than OH&S only. This made it, in practice, very difficult to include it into the bibliographic search using the type of strategy that was chosen.

In general, the comparison shows FIOH to be a very productive OH&S research institute, if not the most productive one in Europe and comparable to NIOSH. The scientific publications of FIOH were also more often cited than the publications of the other European OH&S research institutes.

Figure 6 Publication activity of FIOH, NIOSH and some major European OH&S institutes



The bars show the publication productivity of each institute. The number of personnel per researchers is included in the brackets.

Table 6. The publication productivity of FIOH in comparison to the other major European OH&S institutes and NIOSH (Feb 2nd 2009)

	FIOH	Other European institutes	NIOSH
Results found	1 196	1 716	1 435
Sum of times cited	5 945	6 822	6 565
Citations excluding self-citations	4115	4 676	4 479
Average citations per item	4,97	3,98	4,57
Average citations per item without self-citations	3,44	2,72	3,12
h-index	30	28	29

2.6. Network analysis

National and international cooperation in FIOH scientific reporting was evaluated based on the WoS data. In total, 1 166 publications were grouped according to the types of authors. The following networking options in the authorship of the scientific articles were observed:

- Single author (i.e. no collaboration) 2 %
- Authors from various FIOH units 9 %
- Collaboration between Finnish institutions 51 %
- International collaboration 38 %

International collaboration has increased about 10%, when compared to years 1986-2003.

Networks are an essential component of scientific research because they channel and direct flows of information between researchers both nationally and internationally.

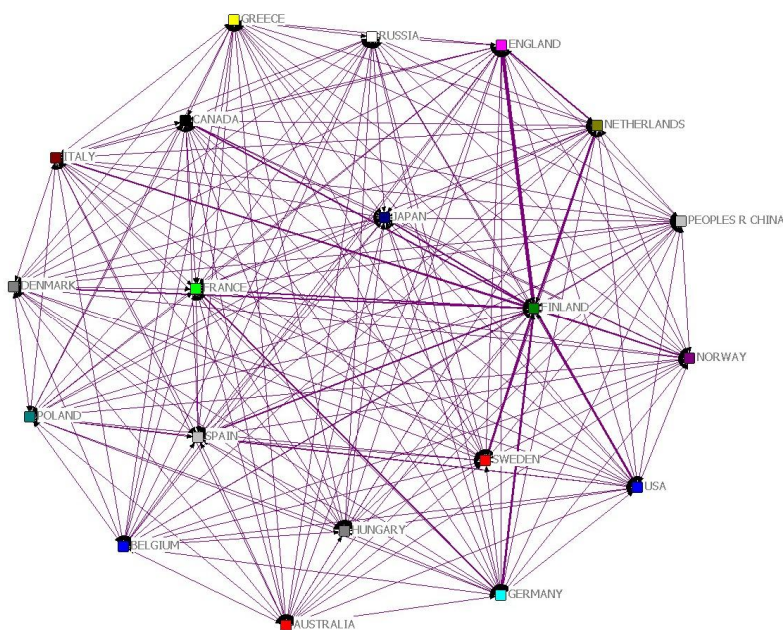


Figure 7. The most active cooperation between countries in article production of FIOH.

The most common national collaborators of the FIOH publications were:

1. University of Helsinki
2. National Public Health Institute
3. University of Oulu
4. University of Kuopio
5. University of Tampere
6. Tampere University Hospital
7. University of Turku
8. Oulu University Hospital
9. Kuopio University Hospital
10. University of Jyväskylä

During the reference period, FIOH researchers published articles with scientists from 62 countries. Most of the co-authors were OH&S researchers from Europe and the USA, whereas some co-authors were based in institutions in Asia, South America or Africa.

The most common international collaborators in FIOH publications were:

1. University College of London; the UK
2. Karolinska Institutet; Sweden
3. University of London- Imperial College - SCI TECHNOL & MED; the UK
4. University of Amsterdam; the Netherlands
5. University of Nottingham, the UK
6. University of Utrecht; the Netherlands
7. IARC, France
8. University of Birmingham, the UK
9. University of Düsseldorf, Germany
10. National Cancer Institute (NCI)

2.7 Bibliometric analysis by journals and research areas

FIOH scientific publications were distributed in about 420 different peer-reviewed journals. Most of them, about 400, are listed in the WoS (WoS, Nov 26th 2008). About 44% of all FIOH articles were published in a group of 40 journals. Those journals were seen as the most important and selected for the journal analysis.

About 17 % of FIOH articles were published in general OH&S journals, which formed the first set chosen for the more detailed analysis (see Table 7). For a more focused view of scientific publishing, other journals were also selected based on their representativeness, importance, quality and scientific impact on the area.

The impact factors of journals differ not only over time, but also across the scientific fields. For example, in 2007, the highest impact factor in the field of occupational health was 2.8 (Occupational and Environmental Medicine). The highest impact factor journals where FIOH researchers published articles within the review period were the Science (IF 26.4) and the Lancet (IF 28.6).

2.7.1. Comparison of publication activity between the major OH&S institutes in the main OH&S journals

Table 7. Publications in the selected OH&S journals (Dec 19th 2008)

Public, Occupational and Environmental Health - category	Impact factor	FIOH	BauA	BGI A	HSL	INRS	ISPESL	STAMI	NRCWE	Nofer	NIOSH
Occupational and Environmental Medicine	2,817	47	1	2	5	6	5	5	18	3	26
Journal of Occupational and Environmental Medicine	2,097	15	0	0	1	0	0	4	9	0	35
American Journal of Industrial Medicine	1,597	19	2	0	0	1	2	6	8	2	79
American Journal of Industrial Medicine	1,493	16	1	4	41	14	1	5	6	1	24
International Archives of Occupational and Environmental Health	1,476	17	3	1	0	11	4	4	12	6	1
Scandinavian Journal of Work Environment & Health	1,387	65	1	0	0	2	0	11	20	0	4
Journal of Occupational and Environmental Hygiene ¹ .	1,207	5	0	5	2	8	2	2	1	0	97
Industrial Engineering											
Ergonomics	1,484	8	0	0	3	4	0	1	3	0	10
Applied Ergonomics	0,948	4	0	1	3	5	0	1	3	0	5
International Journal of Industrial Ergonomics	0,628	9	4	4	1	2	0	0	2	0	13
Records		205	17	17	56	53	14	39	82	12	294

¹. OH&S Journals selection based on the article in Scand J WEH 2007, vol 33, suppl 1. American Industrial Hygiene Association Journal changed its name to the Journal of Occupational and Environmental Hygiene

About 17% of all FIOH articles (1 191 records) were published in journals listed in Table 7. In total, about 950 scientific articles are published in these journals annually.

Obesity											
American Journal of Epidemiology	5,285	10	0	0	0	1	0	1	4	7	29
International Journal of Cancer	4,555	9	1	0	0	0	0	5	4	9	2
European Spine Journal	2,021	7	0	0	0	0	0	0	1	0	0
Records		138	1	0	21	1	3	9	20	24	50

2.7.2.2. Work environment

Articles focused on occupational environment were published by FIOH researchers in about 130 different journals included in the WoS database. Table 9 shows ten of these journals selected for a more detailed evaluation. FIOH articles published in these journals represent about 9% of all articles (from a total of 1 191 records) from FIOH.

All together about 3 000 articles per year were published by the journals listed in Table 9. Limiting from the wider topic category to: "toxicology, acoustics or engineering, industrial" (7 766 records) the FIOH was ranked as 8th of the 500 institutes and universities list with 59 records.

Table 9. Work environment articles in the selected journals (19.12.2008)

Work Environment	Impact factor	FIOH	BauA	BGIA	HSL	INRS	ISPESL	STAMI	NRCWE	Nofer	NIOSH
Toxicology and Applied Pharmacology	3,846	24	0	1	3	3	0	0	1	0	13
Atmospheric Environment	2,549	18	0	0	1	1	2	0	6	0	7
Toxicology Letters	2,826	17	2	2	5	5	19	2	16	29	8
Acta Acustica United with Acustica	0,707	6	0	0	0	2	0	0	0	0	0
Military Medicine	0,601	6	0	0	0	0	0	1	0	0	1
Boreal Environment Research	1,951	5	0	0	0	0	0	0	0	0	0
Building and Environment	0,852	5	0	0	0	0	0	0	1	0	1
Atmospheric Chemistry and Physics	4,865	5	0	0	0	0	0	0	0	0	0
Mutation Research - Fundamental and Molecular Mechanisms of Mutagenesis	4,159	9	0	0	0	1	0	1	12	1	3
Safety Science	0,427	7	0	2	3	8	1	0	3	0	4
Records		102	2	5	12	20	22	4	39	30	37

The total number of publications from three OH&S institutes, i.e. NRCWE, Nofer and NIOSH, taken together reached the record number of FIOH in these journals.

2.7.2.3. Work organization

FIOH articles on work organization were published in about 80 journals of the WoS data. 6,5 % of the FIOH articles were published in journals listed in Table 9. Out of 12 000 records (7.1.2009) found from all these journals published in 2004-2008, about 9 669 were articles, reviews and proceedings. FIOH was 45th on the list of top 500 research institutes and universities. The most productive author overall had 61 articles. Prof. Mika Kivimäki was the second in productiveness with 56 articles, and Prof. Jussi Vahtera the third with 46 articles, as compared to all authors who published in these journals during the period 2004-2008.

In comparison to other OH&S institutes, FIOH was the most active in publishing scientific articles in the journals of Table 10. According to the WoS records, there were 78 scientific papers from FIOH in the listed journals. The NRCWE (National Research Centre for the Working Environment) published 17 scientific papers in the area, also a substantial amount of publications in comparison to the small number of publications in this area from the other OH&S institutes. The Journal of Epidemiology and Community Health was the journal where the FIOH researchers most frequently published papers on work organization issues (Table 10).

Table 10. Publications of OH&S institutes in the selected journals

Work organisation	Impact factor	FIOH	BauA	BGIA	HSL	INRS	ISPESL	STAMI	NRCWE	Nofer	NIOSH
Journal of Epidemiology and Community Health	2,956	21	0	0	0	0	0	0	4	0	0
Social Science & Medicine*	2,453	9	0	0	0	0	0	1	1	0	2
Psychosomatic Medicine	3,109	10	0	0	0	0	0	0	1	0	1
Journal of Psychosomatic Research	1,859	8	0	0	0	0	0	0	1	0	0
Journal of Affective Disorders	3,144	4	0	0	0	0	0	0	0	0	0
Bmc Public Health	1,633	7	0	0	1	1	0	2	2	0	0
Journal of Vocational Behavior*	2,148	5	0	0	0	0	0	0	0	0	1
Personality and Individual Differences	1,400	5	0	0	0	0	0	1	0	0	0
Work and Stress	2,089	4	1	0	1	0	0	0	6	0	0
Social Psychiatry and Psychiatric Epidemiology	1,944	5	0	0	0	0	0	0	2	0	0
Records		78	1	0	2	1	0	4	17	0	4

3. Conclusions

1. Number of publications

FIOH was successful in producing a very high number of publications, 5 637 in total, in 2004-2008. 60% of all the publications were scientific publications and 40% popular and non-scientific publications. Based on the records of the Web of Science and SCOPUS, as well as on a separate selection of top scientific journals in the area, FIOH appears the most productive occupational health and safety research institute in Europe.

Despite a steady publication profile of FIOH over time, in a closer look, the productivity of FIOH, according to the Web of Science and Scopus, nevertheless indicates a fluctuating trend in the total number of international scientific publications during the last five years. Analysis using another measure, the number of scientific publications per researcher year, also has equal tendency. The explanations behind these trends, may include the variation over time in the way the researchers allocate their working hours to activities (i.e. research vs. development), and also attempts to report larger research entities, as well as to make efforts to publish in higher impact journals as competition for external research funding has continuously been increasing.

2. Topic areas of scientific publications

Based on FIOH's publication database (TAVI) from 2004 to 2007, the majority (51%) of the FIOH international peer-reviewed research articles focused primarily on occupational health, one-third on work environment (33%), and one-sixth on work organization (16%). Among the national peer-reviewed research papers, the majority focused on work organization (51%), less on occupational health (36%) and only few on work environment (14 %).

Based on the selected 40 journals, with about 44% of all FIOH articles (recorded in WoS), 17% were published in general OH&S journals, especially in the Scandinavian Journal of Work, Environment & Health, and Occupational and Environmental Medicine. In the area of occupational health (12% of FIOH articles), the most currently used peer-reviewed journals were Spine, Contact Dermatitis, Journal of Allergy and Immunology, American Journal of Epidemiology and the Journal of Sleep Research. In the work environment domain (7% of the articles), most papers were published in Toxicology and Applied Pharmacology, Atmospheric Environment and in the Toxicology Letter. Work Organization (6.5% of FIOH articles) articles were most frequently published in the Journal of Epidemiology and Community Health, Psychosomatic Medicine and Social Science & Medicine.

In 2004-2008, FIOH publications on the following areas increased: biochemistry, genetics and molecular biology, psychology, health professions and neuroscience. Publications on the following areas decreased: pharmacology and toxicology, environmental science, social sciences and chemistry.

3. Citations and productivity

General citations to FIOH papers have grown steadily during the review period, with additional upward steps in 2005 and 2008. The highest numbers of citations were focused on the strategy-based top scientific areas of research: area of genetic research, genotyping studies and genetic toxicology and psychosocial issues and health, and immunotoxicology.

On the list of the 15 most productive researchers during the last five years, prof. Mika Kivimäki was clearly the first, publishing a very high number of epidemiologic papers. However, the other scientists from the Unit of Excellence on Psychosocial issues, Prof. Jussi Vahtera, Dr. Marianna Virtanen and Dr. Jaana Pentti, were also among the most published authors. Several groups within the area of musculoskeletal disorders, as well as the research group of Prof. Harri Alenius (Unit of Excellence on Immunotoxicology) and also groups within area of genetic research, genotyping studies and genetic toxicology belong to the top 20 list. During the entire FIOH history, 53 articles have gained 100 and more citations showing that FIOH has internationally produced an extensive number of substantially cited articles.

4. Collaboration

89% of the FIOH publications are based on collaboration with different national and international research institutes. 38% of the papers result from international collaboration, with the University College of London, Karolinska Institutet and the University of London Imperial College representing the most fruitful international collaboration partners. The most important national collaborators were the University of Helsinki and The Public Health Institute.

In summary, the bibliometric analysis of the scientific and other publication activity of the FIOH highlight the Institute and its researchers as active contributors to the main fields of OH&S research, with a steady publication productivity of over 200 scientific peer-reviewed articles annually. Furthermore, in bibliometric comparisons with other major OH&S institutes, FIOH emerges as an institute with a profile of a high number of scientific papers published in the major journals of the OH&S area. Articles were also published in high numbers among other scientific journals being best suited for the prevailing research fields. This was seen in the analysis of three major topic areas, namely occupational health, work environment and work organization. Finally, the bibliometric analysis indicates that the scientific work the FIOH researchers report on in their papers attracts interest by the scientific community, as evidenced by a high amount of citations. In all, these measures indicate an influential role and a high impact for research carried out by FIOH.

Appendix 1. Methods of bibliometric analysis

1. Search strategy

Search strategies were created for finding the studies and for carrying out analyses (Appendix 1 Search strategies). The first task was to identify affiliations. The names vary from national names to international names; no organization has standardized presentation of its name. The existence of a record with at least one of the names of the organizations chosen for this study either in the address or organization field was the retrieval criterion used.

2. Analysis

Initially it was agreed that the analysis would cover the following sets of indicators:

- Long-term and short-term scientific productivity of FIOH
- Network analysis: the extent of internal, national and international collaboration
- Journals analysis

In these bibliometric analyses, the number, citation and h-indexes and relationship of publications produced by FIOH are compared with other OHS institutes from Europe and the USA.

Co-authoring inside the FIOH, nationally and internationally, is measured. The networks were extracted through linking the institutes as producers of scientific articles into a "co-authoring network". To study, co-authoring editorial pieces and book reviews and meeting abstracts were excluded, and original articles, proceedings and reviews were included. Also, articles that had only one author were excluded. The rest of the articles were divided into three parts: internal cooperation, national and international cooperation.

Several analytic tools for bibliometry are available in SCOPUS and WoS. These were used.

For the comparison of three strategic sectors of FIOH. Scientific articles were classified by using TAVI to the sectors: occupational health, work environment and work organizations. These were used for finding the 10 foremost journals in each sector. In addition, there are OH&S journals which cover all types of OH&S research. A list of 10 general journals was formed using the study of Wegman, D et al. ScandJWEH 2007, vol 33, suppl 1.

3. Search strategies for finding publications of the national research institutes

FIOH

Search limited to years 2004-2008

(OG=(Finnish Inst* Occup* H*) OR OG=(Reg* Inst* Occup* H*) OR OG=(FIOH) OR OG=(Inst* Occup* H* SAME Finland) OR AD=(Kuopio reg* inst* occ* h*) OR

AD=(Oulu reg* inst* occ* h*) OR AD=(Turku reg* inst* occ* h*) OR
AD=(Lappenranta reg* inst* occ* h*) OR AD=(Tampere reg* inst* occ* h*) OR
AD=(Uusimaa reg* inst* occ* h*) OR OG=(Kuopio reg* inst* occ* h*) OR OG=(Oulu
reg* inst* occ* h*) OR OG=(Turku reg* inst* occ* h*) OR OG=(Lappenranta reg*
inst* occ* h*) OR OG=(Tampere reg* inst* occ* h*) OR OG=(Uusimaa reg* inst*
occ* h*) OR AD=(Finnish inst* occ* h*) OR AD=(Reg* Inst* Occup* H*) OR
AD=(FIOH) OR AD=(Inst* Occup* H* SAME Finland)) NOT (PY=2002 OR PY=2003)

BaUA

Search limited to years 2004-2008

(AD=(Fed* Ins* Occup* Safety H*) OR OG=(Fed* Ins* Occup* Safety* H*) OR
AD=(Bundesanstalt Arbeitsschutz & Arbeitsmed) OR OG=(Bundesanstalt
Arbeitsschutz & Arbeitsmed) OR AD=BAuA OR OG=BAuA OR AD=(Bundes* Arbeits*
Arbeitsmed*) OR OG=(Bundes* Arbeits* Arbeitsmed*)) NOT (PY=2002 OR PY=2003)

BGIA

Search limited to years 2004-2008

(AD=(Berufsg* Inst* Arb*) OR OG=(Berufsg* Inst* Arb*) OR AD=(Berufs* Zent*
Sich* Ges*) OR OG=(Berufs* Zent* Sich* Ges*) OR AD=(Inst* Arb* Ges* BGIA) OR
OG=(Inst* Arb* Ges* BGIA) OR AD=(BG inst* Occup* saf* H*) OR OG=(BG inst*
Occup* saf* H*) OR AD=(Inst* Arbeitssch* SAME augustin) OR OG=(Inst*
Arbeitssch* SAME augustin) OR OG=BGIA OR AD=BGIA OR AD=(BIA SAME germany)
OR OG=(BIA SAME germany) OR AD=(BG SAME augustin) OR OG=(BG SAME
augustin)) NOT (PY=2002 OR PY=2003)

HSL

Search limited to years 2004-2008

(AD=(Hlth Saf* Lab* SAME England) OR OG=(Hlth Saf* Lab* SAME England) OR
AD=(Hlth* Saf* Lab* SAME buxton) OR OG=(Hlth* Saf* Lab* SAME buxton) OR
AD=(HSL SAME buxton) OR OG=(HSL SAME buxton) OR AD=(HSL SAME England) OR
OG=(HSL SAME England)) NOT (PY=2002 OR PY=2003)

INRS

Search limited to years 2004-2008

(AD=(INRS SAME nancy) OR OG=(INRS SAME nancy) OR AD=(i* n* R* s* SAME
france) OR OG=(i* N* R* S* SAME france)) NOT (PY=2002 OR PY=2003)

NOFER

Search limited to years 2004-2008

(AD=(Nofer inst* occup* med*) OR OG=(Nofer inst* occup* med*) OR AD=(inst*
occup* med* SAME lodz) OR OG=(inst* occup* med* SAME lodz)) NOT (PY=2003 OR
PY=2004)

NRCWE

Search limited to years 2004-2008

(AD=(NRCWE SAME Copenhagen) OR OG=(NRCWE SAME Copenhagen) OR
OG=(NRCWE SAME Denmark) OR AD=(NRCWE SAME Denmark) OR
OG=(Arbejdsmiljoinst*) OR AD=(Arbejdsmiljoinst*) OR SG=(Arbejdsmiljoinst*) OR
SG=(Inst Occupat Hlth SAME Denmark) OR SG=(dan* Inst* occ* h*) OR OG=(Natl
Res Ctr Working Environm) OR AD=(Natl Res Ctr Working Environm) OR AD=(dan*
Inst* occup* h*) OR OG=(dan* Inst* occup* h*) OR AD=(Inst Occupat Hlth SAME
Denmark) OR OG=(Inst Occupat Hlth SAME Denmark) OR AD=(Natl Inst Occupat Hlth
SAME Denmark) OR OG=(Natl Inst Occupat Hlth SAME Denmark)) NOT (PY=2002 OR
PY=2003)

ISPESL

Search limited to years 2004-2008

(AD=(ISPESL SAME Italy) OR OG=(ISPESL SAME ITALY) OR AD=(ist* sup* prev* sic* SAME Italy) OR OG=(ist* sup* prev* sic* SAME italy) OR AD=(i* S* p* E* S* L* SAME rome) OR OG=(i* S* p* E* S* L* SAME rome)) NOT (PY=2002 OR PY=2003)

STAMI

Search limited to years 2004-2008

(AD=(Nat* Inst* Occup* H* SAME Oslo) OR OG=(Nat* Inst* Occup* H* SAME Oslo) OR AD=stami OR OG=stami OR AD=(Stat* Arbets*) OR OG=(Stats* Arbets*) OR AD=(Nat* Inst* Occup* H* SAME Norway) OR OG=(Nat* Inst* Occup* H* SAME Norway)) NOT (PY=2002 OR PY=2003)

NIOSH

Search limited to years 2004-2008

(AD=(NIOSH SAME USA) OR OG=(NIOSH SAME USA) OR AD=(NIOS SAME US) OR OG=(NIOSH SAME US) OR OG=(Nat* Inst* Occup* Hlth SAME USA) OR AD=(Nat* Inst* Occup* Hlth SAME USA)) NOT (PY=2002 OR PY=2003)

Appendix 2. Most cited 20 FIOH papers 2004-2008.

The top 20 papers out of 985 records, articles, and reviews ranked by citations (2004-2008) (12.1.2009)

	2005	2006	2007	2008	2009	Total	Average Citations per Year
	398	858	1465	2439	67	5,279	879.83
1. Author(s): Laitinen, T; Polvi, A; Rydman, P; et al. Title: Characterization of a common susceptibility locus for asthma-related traits Source: SCIENCE, 304 (5668): 300-304 APR 9 2004 ISSN: 0036-8075	45	47	28	25	0	163	27.17
2. Author(s): Vodicka, P; Kumar, R; Stetina, R; et al. Title: Genetic polymorphisms in DNA repair genes and possible links with DNA repair rates, chromosomal aberrations and single-strand breaks in DNA Source: CARCINOGENESIS, 25 (5): 757-763 MAY 2004 ISSN: 0143-3334	16	22	20	17	1	80	13.33
3. Author(s): Hagmar, L; Stromberg, U; Bonassi, S; et al. Title: Impact of types of lymphocyte chromosomal aberrations on human cancer risk: Results from Nordic and Italian cohorts Source: CANCER RESEARCH, 64 (6): 2258-2263 MAR 15 2004 ISSN: 0008-5472	9	16	19	15	1	61	10.17
4. Author(s): Bonassi, S; Znaor, A; Ceppi, M; et al. Title: An increased micronucleus frequency in peripheral blood lymphocytes predicts the risk of cancer in humans Source: CARCINOGENESIS, 28 (3): 625-631 MAR 2007 ISSN: 0143-3334			10	45	1	56	18.67
5. Author(s): Vahtera, J; Kivimaki, M; Pentti, J; et al. Title: Organisational downsizing, sickness absence, and mortality: 10-town prospective cohort study Source: BRITISH MEDICAL JOURNAL, 328	8	10	18	19	0	55	9.17

	2005	2006	2007	2008	2009	Total	Average Citations per Year
	398	858	1465	2439	67	5,279	879.83
(7439): 555-558 MAR 6 2004 ISSN: 0959-535X							
6. Author(s): Vahtera, J; Pentti, J; Kivimaki, M Title: Sickness absence as a predictor of mortality among male and female employees Source: JOURNAL OF EPIDEMIOLOGY AND COMMUNITY HEALTH, 58 (4): 321-326 APR 2004 ISSN: 0143-005X	11	8	12	19	1	52	8.67
7. Author(s): Sonkoly, E; Muller, A; Lauerma, AI; et al. Title: IL-31: A new link between T cells and pruritus in atopic skin inflammation Source: JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, 117 (2): 411-417 FEB 2006 ISSN: 0091-6749		13	18	17	3	51	12.75
8. Author(s): Gombert, M; Dieu-Nosjean, MC; Winterberg, F; et al. Title: CCL1-CCR8 interactions: An axis mediating the recruitment of T cells and Langerhans-type dendritic cells to sites of atopic skin inflammation Source: JOURNAL OF IMMUNOLOGY, 174 (8): 5082-5091 APR 15 2005 ISSN: 0022-1767	1	17	14	16	1	49	9.80
9. Author(s): Kettunen, E; Anttila, S; Seppanen, JK; et al. Title: Differentially expressed genes in nonsmall cell lung cancer: expression profiling of cancer-related genes in squamous cell lung cancer Source: CANCER GENETICS AND CYTOGENETICS, 149 (2): 98-106 MAR 2004 ISSN: 0165-4608	16	9	10	6	0	42	7.00
10. Author(s): Solovieva, S; Leino-Arjas, P; Saarela, J; et al. Title: Possible association of interleukin 1 gene locus polymorphisms with low back pain Source: PAIN, 109 (1-2): 8-19 MAY 2004 ISSN: 0304-3959	8	9	11	12	0	40	6.67

	2005	2006	2007	2008	2009	Total	Average Citations per Year
	398	858	1465	2439	67	5,279	879.83

	2005	2006	2007	2008	2009	Total	Average Citations per Year
	398	858	1465	2439	67	5,279	879.83
11. Author(s): Kivimaki, M; Ferrie, JE; Brunner, E; et al. Title: Justice at work and reduced risk of coronary heart disease among employees - The Whitehall II Study Source: ARCHIVES OF INTERNAL MEDICINE, 165 (19): 2245-2251 OCT 24 2005 ISSN: 0003-9926	0	4	14	17	0	35	7.00
12. Author(s): Kivimaki, M; Forma, P; Wikstrom, J; et al. Title: Sickness absence as a risk marker of future disability pension: the 10-town study Source: JOURNAL OF EPIDEMIOLOGY AND COMMUNITY HEALTH, 58 (8): 710-711 AUG 2004 ISSN: 0143-005X	5	7	7	13	2	34	5.67
13. Author(s): Lehtonen, R; Kiuru, M; Vanharanta, S; et al. Title: Biallelic inactivation of fumarate hydratase (FH) occurs in nonsyndromic uterine leiomyomas but is rare in other tumors Source: AMERICAN JOURNAL OF PATHOLOGY, 164 (1): 17-22 JAN 2004 ISSN: 0002-9440	11	9	7	5	2	34	5.67
14. Author(s): Laitinen, J; Pietilainen, K; Wadsworth, M; et al. Title: Predictors of abdominal obesity among 31-y-old men and women born in Northern Finland in 1966 Source: EUROPEAN JOURNAL OF CLINICAL NUTRITION, 58 (1): 180-190 JAN 2004 ISSN: 0954-3007	7	6	8	10	0	34	5.67
15. Author(s): Kouvonen, A; Kivimaki, M; Virtanen, M; et al. Title: Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees Source: JOURNAL OF EPIDEMIOLOGY AND COMMUNITY HEALTH, 59 (1): 63-69 JAN 2005 ISSN: 0143-005X	2	6	11	14	0	33	6.60
16. Author(s): Jarvelin, MR; Sovio, U; King, V; et al. Title: Early life factors and blood pressure at age 31 years in the 1966 northern Finland birth	1	2	15	14	0	32	5.33

	2005	2006	2007	2008	2009	Total	Average Citations per Year
	398	858	1465	2439	67	5,279	879.83
cohort Source: HYPERTENSION, 44 (6): 838-846 DEC 2004 ISSN: 0194-911X							
17. Author(s): Hussein, T; Puustinen, A; Aalto, PP; et al. Title: Urban aerosol number size distributions Source: ATMOSPHERIC CHEMISTRY AND PHYSICS, 4: 391-411 MAR 1 2004 ISSN: 1680-7324	8	6	8	10	0	32	5.33
18. Author(s): Kivimaki, M; Virtanen, M; Elovainio, M; et al. Title: Work stress in the etiology of coronary heart disease - a meta-analysis Source: SCANDINAVIAN JOURNAL OF WORK ENVIRONMENT & HEALTH, 32 (6): 431-442 DEC 2006 ISSN: 0355-3140		0	6	22	2	30	10.00
19. Author(s): Basketter, DA; Andersen, KE; Liden, C; et al. Title: Evaluation of the skin sensitizing potency of chemicals by using the existing methods and considerations of relevance for elicitation Source: CONTACT DERMATITIS, 52 (1): 39-43 JAN 2005 ISSN: 0105-1873	2	7	7	14	0	30	6.00
20. Author(s): Husgafvel-Pursiainen, K Title: Genotoxicity of environmental tobacco smoke: a review Source: MUTATION RESEARCH-REVIEWS IN MUTATION RESEARCH, 567 (2-3): 427-445 NOV 2004 ISSN: 1383-5742	5	4	11	10	0	30	6.00