The Societal Impact

of Novo Nordisk Foundation Grants

HIGHLIGHTS
FROM THE FULL
2016 ANNUAL REPORT

novo nordisk fonden

September 2017

Through its grant-awarding activities, the Foundation catalyses the creation of strong public research environments, opens a gateway to the best global scientific communities and supports collaboration between public research and research-based companies.

Since 1927, the Foundation has awarded grants to researchers at universities and hospitals in Denmark and the other Nordic countries. Today, the Foundation supports research in biomedicine, biotechnology, general practice, nursing, art history and also scientific objectives within innovation, education and outreach as well as humanitarian and social purposes.

The purpose of the impact report is to provide an overview of how grant-awarding activities support the Foundation's ambition of promoting a knowledge-based society to improve the health and welfare of people. It documents the Foundation's input of resources to the scientific communities and the subsequent effects on research, education, health, and research-industry collaboration activities.

Introduction to the booklet

The booklet contains highlights from the full annual report *The Societal Impact of Novo Nordisk Foundation Grants*. Like the annual report, the booklet is divided into six sections:

- How the Foundation contributes to society: shows how much the Foundation has contributed to research in Denmark, both monetarily and the number of researchers receiving funding.
- Production of knowledge and research education: explains how many publications the recipients of Foundation grants have published, how many journal articles they have co-authored and how many PhD students and postdoctoral fellows the Foundation finances.
- Dissemination and use of knowledge within academia: shows that the citation impact of the recipients of Foundation grants is similar to those of the best universities in the world.
- Dissemination and use of knowledge within the public sector: explains that the recipients of Foundation grants are relatively often referenced in clinical guidelines within cardiovascular diseases and diabetes, which influences the treatment of patients.
- Dissemination and use of knowledge within the private sector: shows that the collaboration between recipients of Foundation grants and the private sector has grown in terms of the number of co-authored publications, commercialization activities and number of spin-outs.
- Case study: Hallas-Møller Investigator grant recipients: shows the career development of young research leaders who received the Hallas-Møller Investigator grant between 1985 and 2016.

VISION AND GOALS

The Foundation's vision is to contribute significantly to research and development that improves the health and welfare of people.

The Board of Directors of the Novo Foundation has set the following strategic goals for the Foundation:

Societal goals

With Denmark as the Foundation's centre of gravity, the focus is:

- To promote world-class research and innovation in the medical, biotechnological and natural sciences and help to foster a world-class education system.
- To help to develop a knowledge-based society that contributes to long-term economic activity and job creation for improving general health and welfare.

Commercial goals

- Be a strong owner of the companies in the Novo Group.
- Generate attractive returns for the Foundation on its financial investment portfolio.
- Make investments with the main goal of promoting knowledge and world-class research.

Goals for grant activities

- Strengthen biomedical and biotechnology research in selected fields.
- Fuel cross-disciplinarity.
- Advance individual scientific excellence.
- Spur imagination, inspiration and knowledge about science and technology.
- Build bridges between scientific discoveries and their commercial applications.
- Achieve social and humanitarian impact.

DKK 4.2 billion and DKK 1.1 billion in grant-awarding and payouts in 2016

HOW THE FOUNDATION CONTRIBUTES TO SOCIETY

The private foundations accounted for 14% of the total funding of research in the public sector in Denmark in 2016.

The Novo Nordisk Foundation accounted for 5%. Private foundations, including the Novo Nordisk Foundation, have more than doubled their funding for public research in Denmark as a percentage of GDP since 2007.

People involved in research

During 2016, almost 2000 people have been involved in research activities either fully or partly financed by the Foundation. This include principal investigators on grants, PhD students, postdoctoral fellows, etc.

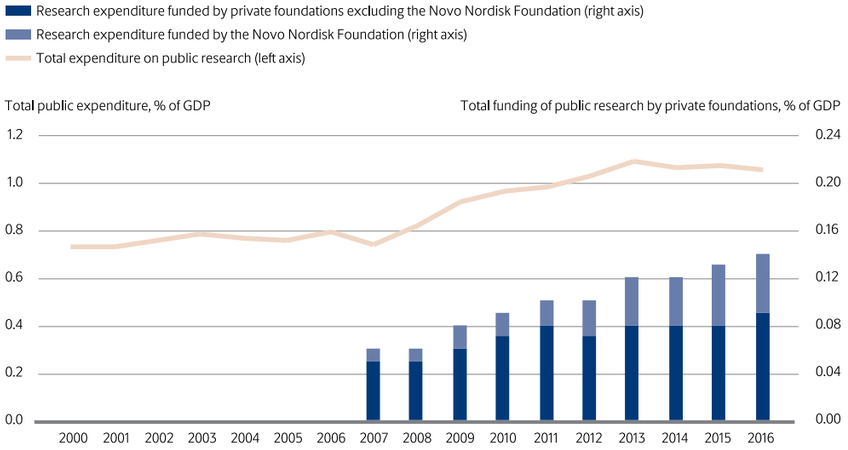
Research activities currently support an estimated 1000 PhD students and postdoctoral fellows. The Foundation supports 18% of the PhD students who began their PhD study in 2013–2015 within biomedicine in Denmark.

The Foundation's research centres employ around 800 people, and more than half (54%) of the scientific personnel funded by the Foundation are recruited outside Denmark.

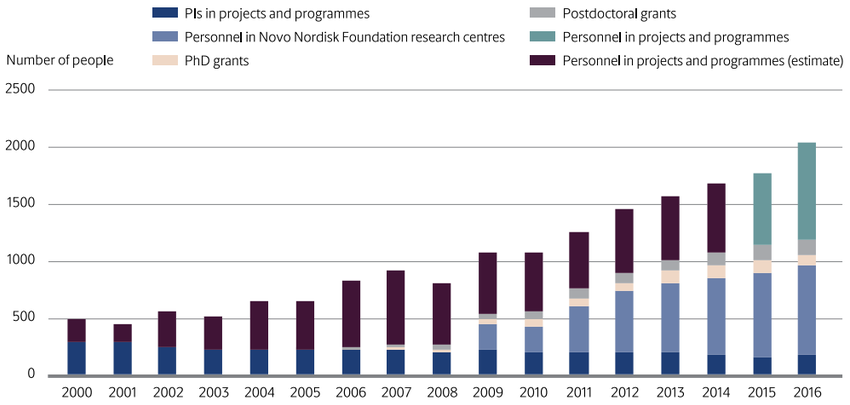
The Foundation's
annual payout has risen
from DKK 170 million to
DKK 1134 million
since 2007

Almost
2000
people
were either fully or partly financed
through Foundation grants in 2016

Total expenditure on public research and funding of public research by private foundations in Denmark as a percentage of GDP, 2000–2016



Number of people either fully or partly financed by Foundation grants, 2000–2016



PRODUCTION OF KNOWLEDGE AND RESEARCH EDUCATION

The recipients of Foundation grants have published more than 15,400 publications since 2000.

The recipients of Foundation grants published 6.4% of the total journal articles for Denmark from 2012 to 2015.

Grant recipients have full publishing freedom and can decide their own research priorities.

International benchmark on journal articles

Denmark ranks number 2 after Switzerland among the Organisation for Economic Co-operation and Development (OECD) countries in number of journal articles per million population. Researchers in Switzerland published 4800 articles per million population versus 4065 for Denmark.

The recipients of Foundation grants published 2341 journal articles in 2015. This is equivalent to 412 articles per million population, or 10.1% of the total number of journal articles by researchers in Denmark during 2015.

Denmark produces a high number of journal articles per million population compared with other countries because of the high level of public research in relation to GDP and a relatively high concentration of researchers in the population. Researchers in Denmark published 1.5 journal articles on average in 2012–2015, the same as the recipients of Foundation grants.

Collaboration on co-authored journal articles increases

Research is produced across national borders and across public and private organizations. The number of journal articles by the recipients of Foundation grants with co-authorship within academia increased nearly five times from 2000–2001 to 2014–2015.

The number of international co-authored journal articles (academia) in Denmark is 2067 per million population according to the EU's European Innovation Scoreboard; the number of international co-authored journal articles (academia) by the recipients of Foundation grants for the same period is 140 per million population. Hence, the recipients of Foundation grants account for 7% of all international co-authored journal articles (across all sciences) in Denmark in 2015. Further, the grant recipients account for 0.55% of all international co-authored journal articles in the other Nordic countries.

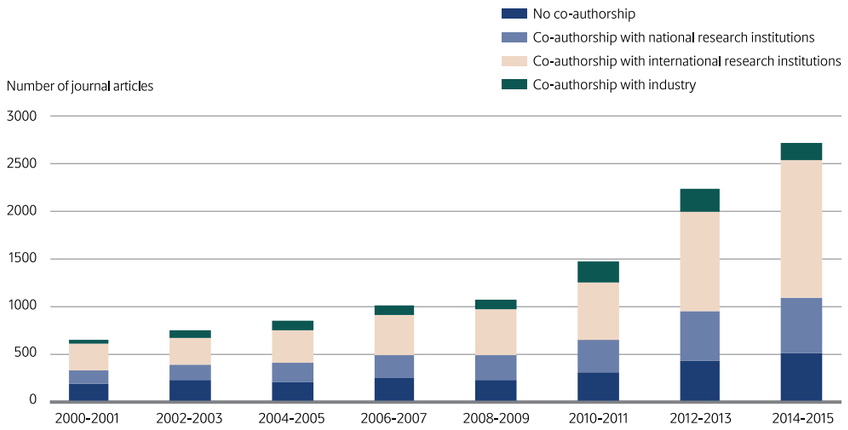
90% of the publications funded by the Foundation **were published in research journals**

About **20%** of the journal articles **funded by the Foundation are categorized under endocrinology and metabolism**

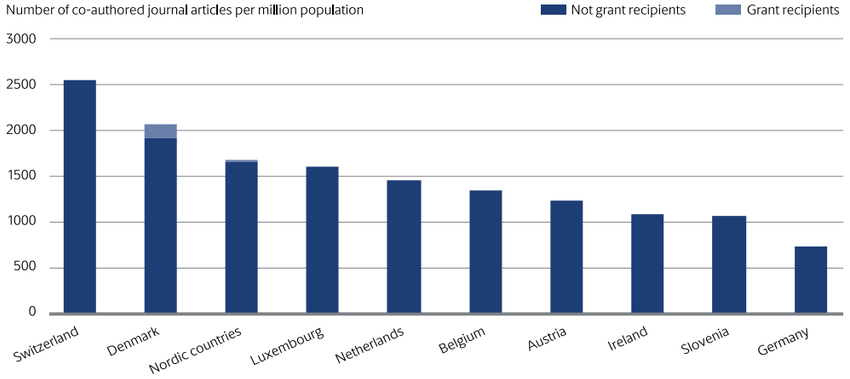
75% of the publications **by grant recipients are co-authored with researchers from other academic institutions**

53% have international academic co-authors

Journal articles by co-authorship, 2000–2016



Internationally co-authored journal articles within academia by country of origin, 2015



DISSEMINIATION AND USE OF KNOWLEDGE WITHIN ACADEMIA

The recipients published 13,859 journal articles based on Foundation grants since 2000, which were cited a total of 66,068 times in 2015 and 76,401 times in 2016. The average number of citations per journal article in the period 2000–2016 is 32.7.

The recipients published in 1672 research journals world-wide from 2000 to 2016.

Citation impact among the highest worldwide

The citation impact of the journal articles by the recipients of Foundation grants published in the period 2011–2014 is high and equivalent to those of the best universities in Europe, such as the University of Oxford, and the citation impact of the Foundation's four research centres is equivalent to that of the best university in the world.

Denmark ranks fourth on the citation impact of journal articles on the EU's European Innovation Scoreboard, with 13% of the journal articles from Denmark among the 10% most frequently cited worldwide. That share is 22% for articles by Foundation-supported researchers.

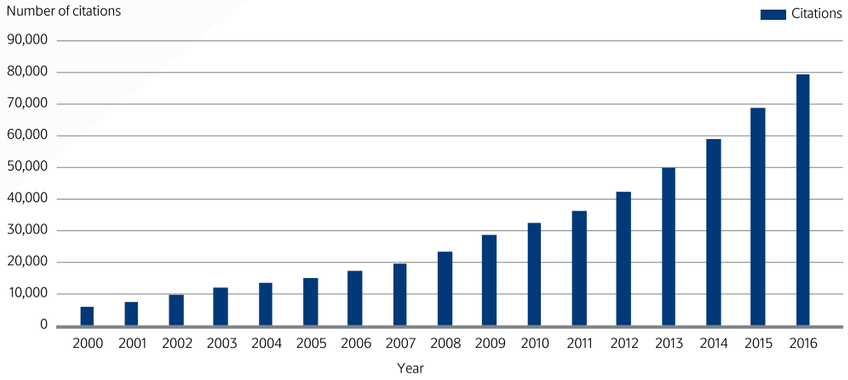
International co-authored journal articles have high impact

Collaboration with researchers from institutions within and outside Denmark can enhance knowledge. Co-authors of the recipients of Foundation grants are located in 120 countries and cover all continents except Antarctica.

In 2012–2014, grant recipients who had co-authors outside their own institution versus researchers without co-authors outside their own institution had 1.3 times more journal articles among the 10% most frequently cited journal articles and four times more journal articles among the 1% most frequently cited journal articles.

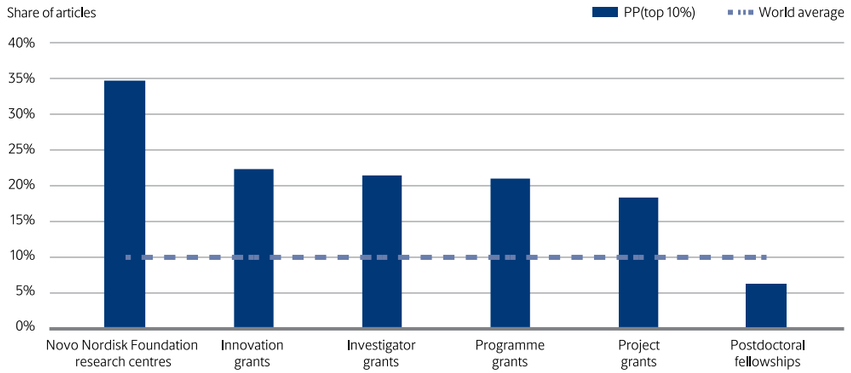
516,134
citations
cumulative
since 2000

Number of citations for journal articles from recipients of Foundation grants, 2000–2016



9.5% of the journal articles by **the four Foundation research centres**
are among the
1% most frequently cited worldwide
2000–2014

Citation impact of journal articles by type of grant – PP(top 10%), 2000–2014



DISSEMINATION AND USE OF KNOWLEDGE WITHIN THE PUBLIC SECTOR

53% of the 100 identified diabetes guidelines contain references to publications published by the recipients of Foundation grants.

18% of the 276 identified cardiovascular disease guidelines have references to publications by the recipients of Foundation grants.

What are clinical Guidelines?

Clinical guidelines gather the best and most current evidence about the prevention, diagnosis, prognosis and therapy of clinical problems.

Time lag from research idea to a guideline reference

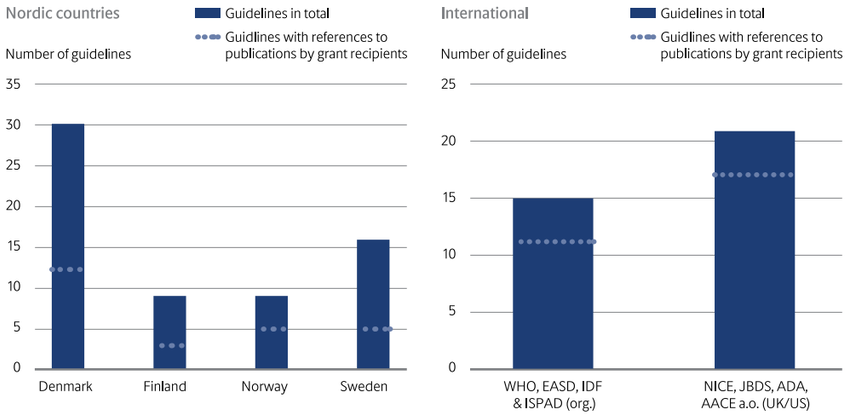
A publication being referenced in a clinical guideline indicates that the research is likely to influence the treatment of patients.

The time lag from the date of publication of a cited research article to the date of publication of the diabetes guideline averages 5 years. For the cardiovascular disease guidelines, the average time lag is 2 years from the time of publication until it is referenced in a guideline.

Time lag from a project idea to a guideline reference

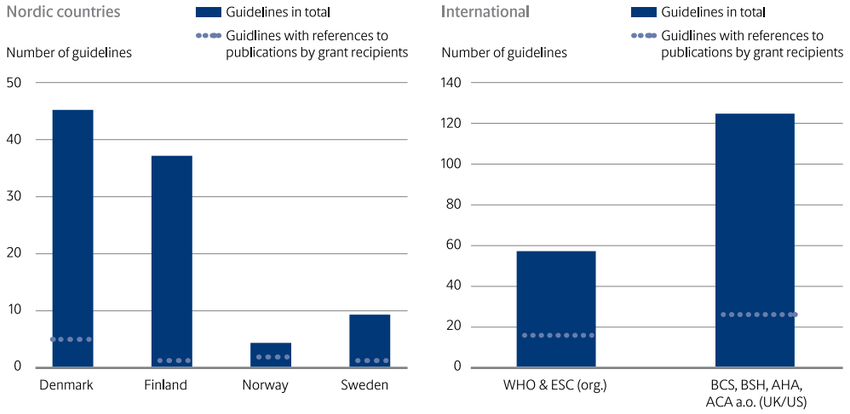
53% of diabetes guidelines refer to publications by grant recipients

Diabetes guidelines by origin, 2000–2016



18% of cardiovascular guidelines refer to publications by grant recipients

Cardiovascular guidelines by origin, 2000–2016



DISSEMINATION AND USE OF KNOWLEDGE WITHIN THE PRIVATE SECTOR

The number of publications by grant recipients which are co-authored with industrial researchers rose from 11 in 2000 to 95 in 2015.

The Foundation accounts for 12% of all publications co-authored with industry in Denmark in 2015.

The research results of the grant recipients belong to the researchers and their research institute.

Co-authorship with industry has strong impact

Researchers in Denmark produced 143.5 journal articles co-authored with industry in 2015 per million population (including publications by the recipients of Foundation grants). Foundation-funded researchers produced 17 journal articles co-authored with industrial researchers per million population.

19% of grant recipients publications co-authored with industrial researchers were among the 10% most frequently cited publications worldwide between 2000 and 2004. That share increased to 31% in 2010–2014, implying that the share rose from a high level by international comparison to a very high level. This increase outperforms the increase for purely academic publications among the 10% most frequently cited publications worldwide, which grew from 16% to 19%.

Spin-out and commercialization activities

Spin-outs from public research benefit local economic development and create new jobs. Spin-outs often transform the technological inventions developed from public research into goods or services.

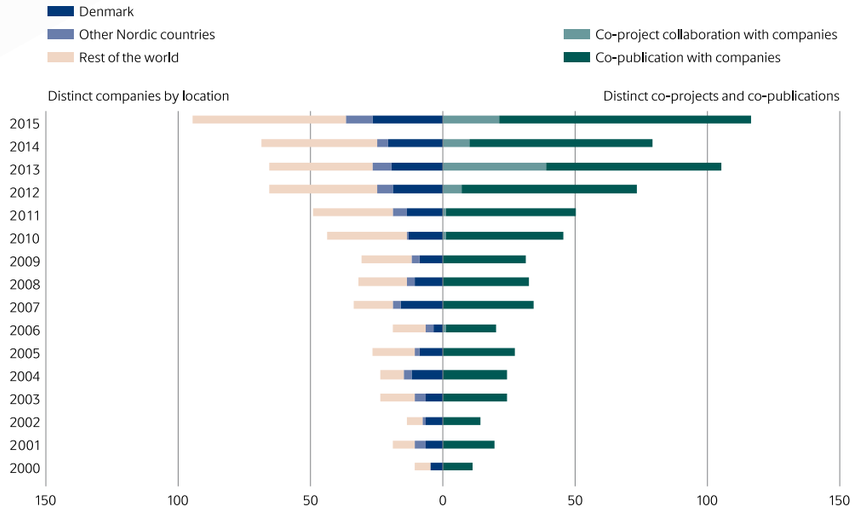
Since 2012, 23 spin-outs have been created based on research funded by the Foundation.

Besides spin-outs, the recipients of Foundation grants have reported the following innovation and commercialization activities arising between 2012 and 2016: 47 patent applications and 12 patents, which is 5% of all patents produced by research institutions in Denmark for these years.

8% of journal articles **by grant recipients** co-authored with industrial researchers **are among the 1% most frequently cited**

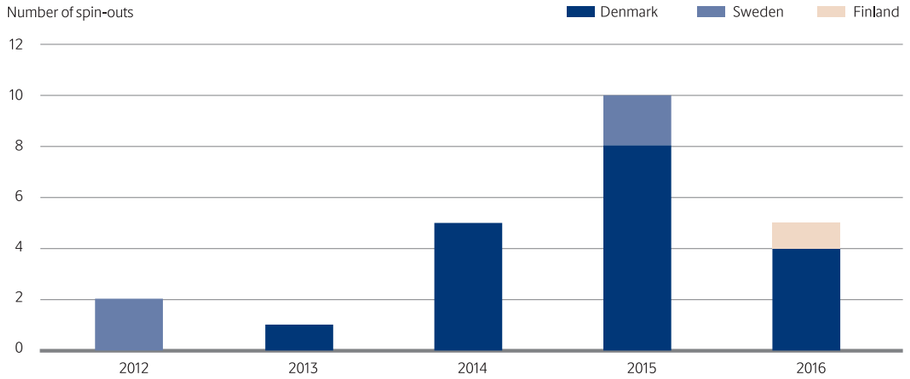
60% of the partner companies in research projects and published research publications are non-Nordic

Number of distinct companies collaborating with grant recipients by origin, and number of distinct collaborations between companies and grant recipients, 2000–2015



One in 10 academic publications were co-authored by industrial researchers

Spin-outs by recipients of Foundation grants by country of origin, 2012–2016



CASE STUDY: HALLAS-MØLLER INVESTIGATOR GRANT RECIPIENTS

The aim of the Hallas-Møller Investigator grant is to strengthen the development of young research leaders within the field of basic biomedical reasearch but also within wider natural sciences that are of general importance for the understanding of the human organism.

The recipients undertake research at Danish research institutions, and the support from the Foundation enables them to establish or expand their research group.

Where on their career path were the grant recipients in 2016?

Half the recipients were in time-limited positions when their grant started. In 2016, all recipients who have completed their grant were in a permanent position. 17 of 25 were full professors. Half of the professorships were attained 6 years after the grant was awarded.

International citation impact

Between 21% and 24% of journal articles are among the world's 10% most frequently cited within their journal subject category and 1.5% to 2.5% are among the world's 1% most frequently cited journal articles.

The most frequent journal the recipients published in was *Journal of Biological Chemistry*.

> The Hallas-Møller Investigator fellowship was definitely a decisive factor in my career development. It provided me an opportunity for immersion without having to worry about teaching obligations or financial issues and opened many doors in academia.
>
> **- Citation by one grant recipient**

Flowchart of the 25 recipients of Foundation grants who completed their project