Different Pathomechanisms for Asthma and Allergies (NEJM 363:121ff)

Genetics of Complex Diseases Unraveled by Combining GWAS and Metabolomics (Nature Genetics 42:137. PLoS Genetics 4:1)

Disease Management Programs Substantially Improve Healthcare Quality in Diabetics (Betriebswirtschaftliche Forschung und Praxis 61:283)

New Gene Variants for Diabetes – Influence on the Function of Beta Cells (Genetics 2010 42(2):105ff)

Infant-Onset Eczema in Relation to Mental Health Problems at Age 10 (JACI 125:404ff)

Particulate Matter Influences the Course of Cardiovascular Diseases (Circulation 121:2331ff)
Population-based health research faces a major challenge. Due to changed living conditions, chronic, complex diseases such as diabetes, lung diseases or cardiovascular diseases top the list of threats to the health of the population. Only with reliable data, on the incidence and spread of these diseases can researchers make validated statements about their pathogenesis. Together with healthcare data these enable the identification of effective and economically feasible measures to combat these diseases. On the basis of population-based studies, Helmholtz Zentrum München investigates the interactions between genetic causes and environmental factors in the pathogenesis of complex, chronic diseases. It thus illuminates the complex causal relationships, evaluates healthcare options and makes crucial contributions to the development of new therapies, diagnostic methods and prevention strategies.

With the central KORA cohort study, Helmholtz Zentrum München conducts population-based health research at the highest level. In the KORA network, Helmholtz epidemiologists and health economists cooperate with numerous national and international research partners on population-representative surveys and respective follow-up studies. To provide a long-term database for the early detection and prevention of major widespread diseases, Helmholtz Zentrum München, in cooperation with partners, is also building up the national cohort with 200,000 – presently healthy – participants. The aim of this national cohort is to identify risk factors for chronic diseases and to develop new, personalized approaches for diagnosis and therapy.

With the Graduate School of Environmental Health (HELENA), Helmholtz Zentrum München is also setting standards in the education and training of the young generation of scientists. One important module in the training is epidemiology. As partner in the Pettenkofer School of Public Health and the Business School of LMU, Helmholtz Zentrum München is continuing to expand its focus on population-based studies.

---

**Changing Incidence of Diseases**

<table>
<thead>
<tr>
<th>Year</th>
<th>Disease</th>
<th>2004</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower respiratory infections (e.g. pneumonia)</td>
<td>6.2%</td>
<td>3.2%</td>
</tr>
<tr>
<td></td>
<td>Diarrhoeal diseases</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unipolar depressive disorders</td>
<td>4.3%</td>
<td>6.2%</td>
</tr>
<tr>
<td></td>
<td>Ischaemic heart disease (e.g. heart attack)</td>
<td>1.9%</td>
<td>5.5%</td>
</tr>
<tr>
<td></td>
<td>Cerebrovascular diseases (e.g. stroke)</td>
<td>4.3%</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Chronic obstructive pulmonary disease, COPD</td>
<td>3.8%</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Lower respiratory infections (e.g. pneumonia)</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prematurity and low birth weight</td>
<td>2.9%</td>
<td>2.9%</td>
</tr>
<tr>
<td></td>
<td>Birth asphyxia and birth trauma</td>
<td>2.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>road traffic accidents</td>
<td>2.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>Neonatal infections and other diseases in newborns</td>
<td>2.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>Chronic obstructive pulmonary disease (COPD)</td>
<td>2.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td>Refractive errors</td>
<td>1.8%</td>
<td>1.9%</td>
</tr>
<tr>
<td></td>
<td>Hearing loss, adult onset</td>
<td>2.9%</td>
<td>2.9%</td>
</tr>
<tr>
<td></td>
<td>Refractive errors</td>
<td>2.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td>HIV/AIDS</td>
<td>3.8%</td>
<td>2.5%</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>2.3%</td>
<td>2.3%</td>
</tr>
<tr>
<td></td>
<td>Neonatal infections and other diseases in newborns</td>
<td>1.9%</td>
<td>1.9%</td>
</tr>
<tr>
<td></td>
<td>Prematurity and low birth weight</td>
<td>1.9%</td>
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</tr>
<tr>
<td></td>
<td>hearing loss, adult onset</td>
<td>1.8%</td>
<td>1.8%</td>
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<td>Birth asphyxia and birth trauma</td>
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<td>1.9%</td>
</tr>
<tr>
<td></td>
<td>Diabetes mellitus</td>
<td>1.3%</td>
<td>1.3%</td>
</tr>
<tr>
<td></td>
<td>Diarrhoeal diseases</td>
<td>1.6%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

Source: WHO; representation of the disability-adjusted life years (DALY)
Leading Science to Health

Use in Society → Application

Population-based studies to aid in the prevention, diagnosis and therapy of major chronic diseases

Translational Research, Technology Transfer

Leitmotif Environmental Health

Cooperations

Excellent Research
4 institutes, 1 research unit, 1 clinical cooperation group

Excellent Education and Training
HELENA – Helmholtz Graduate School of Environmental Health, Pettenkofer School of Public Health, Master of Business Research Program

Excellent Platforms
KORA studies platform, human biosamples database, Genome Analysis Center, metabolomics platform, aerosol measuring station

As German Research Center for Environmental Health, Helmholtz Zentrum München pursues the goal of developing personalized medical approaches for the prevention and therapy of major common diseases such as diabetes mellitus and lung diseases. To achieve this, it investigates the interaction of genetics, environmental factors and lifestyle. The head office of the center is located in Neuherberg to the north of Munich. Helmholtz Zentrum München is a member of the Helmholtz Association, a community of 17 scientific-technical and medical-biological research centers with a total of about 31,000 staff members.

The research focus of Helmholtz Zentrum München is on widespread common diseases. Population-based studies (1) make important contributions to the investigation of the relationships between genetic and environmental risk factors in the development of complex chronic diseases and to their prevention and treatment. Environmental Health (2) is the leitmotif of our research: We investigate the relationships between man, his living conditions and his genetic predisposition. The researchers work closely with clinics to transfer insights gained through translational research (3) as fast as possible to medical practice for the benefit of patients. This goal is based on excellent research (4), education and training (5), platforms (6) and cooperations (7). Four institutes, one department and various platforms contribute to achieving this objective.

Key Contact Persons for Research

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Our Expertise in Population-Based Studies

KORA – Cooperative Health Research in the Region of Augsburg
- **Speaker:** Prof. Dr. Dr. H.-Erich Wichmann
- **Management:** Institutes of Epidemiology and Health Economics
- Cohort with 20,000 study participants, on the basis of regular medical examinations over the past 25 years
- Network of epidemiological and health economics research approaches
- One of the aims: To determine, over a lengthy time span, the incidence of diseases, multimorbidity, healthcare provision, environmental burdens and lifestyle factors from the psyche to genetics
→ www.helmholtz-muenchen.de/kora

Institutes of Epidemiology
- **Directors:** Prof. Dr. H.-Erich Wichmann and Prof. Dr. Annette Peters
- One of the aims: to investigate the role of environmental and lifestyle factors and genetic predispositions on human health with epidemiological methods
- Multivariate relationships found between environmental factors and genes in the pathogenesis of complex diseases such as diabetes, obesity or cardiovascular diseases in adults and children
→ www.helmholtz-muenchen.de/epi
→ www.helmholtz-muenchen.de/epi2

Institute of Health Economics and Healthcare Management
- **Director:** Prof. Dr. Reiner Leidl
- One of the aims: to determine the costs of diseases, patients’ quality of life and economic feasibility of medical measures
- to define the effects of socioeconomic factors on health and healthcare
- to conduct health economics studies in the areas of cardiovascular diseases, diabetes, COPD, dementia and multimorbidity in old age
→ www.helmholtz-muenchen.de/igm

Institute of Genetic Epidemiology
- **Director:** Prof. Dr. Konstantin Strauch
  (Chair of Genetic Epidemiology at Ludwig-Maximilians-Universität München)
- One of the aims: planning, conducting and evaluating genetic epidemiological studies
- development of statistic methods for genetic epidemiology

Research Unit Molecular Epidemiology
- **Head:** Prof. Dr. Thomas Illig
- One of the aims: to study which genes influence the individual genetic predisposition for complex diseases such as diabetes, asthma or cardiovascular diseases.
- to determine the genetic profiles in KORA and other cohort participants
- Participation in international research consortia such as DIAGRAM (Diabetes Genetics Replication and Meta-Analysis) or MAGIC (Meta-Analyses of Glucose and Insulin-related traits Consortium)
→ www.helmholtz-muenchen.de/epi

Clinical Cooperation Group Allergy and Environment
- **Head:** Prof. Dr. Carsten Schmidt-Weber
  (Director of the MARC Munich Allergy Research Center)
- One of the aims: to elucidate the effect of environmental factors on the development, triggering and chronification of allergic reactions
→ www.helmholtz-muenchen.de/forschung/forschungseinrichtungen/umwelt-dermatologie-und-allergologie/index.html

Genome Analysis Center and Metabolomics Platform MetaP
- **Head:** Prof. Dr. Jerzy Adamski
  (Head of the Genome Analysis Center, Coordinator MetaP)
- One of the aims: to elucidate the relationships between metabolism and health risks
→ www.helmholtz-muenchen.de/gac/metabolomics/index.html

Aerosol Measuring Station
- **Head:** Prof. Dr. Annette Peters
- Comprehensive collection and characterization of fine and ultrafine particles from ambient air
- One of the aims: modern measurements of the environment in cooperation with the University of Augsburg and the Augsburg University of Applied Sciences
→ www.helmholtz-muenchen.de/igm

The Department of Epidemiology has been founded in January 2011 at Helmholtz Zentrum München and is due to begin work in 2011. It unites the epidemiological research conducted at the institutes and research units under one roof.
### Population-Based Studies at Helmholtz Zentrum München

#### Projects

<table>
<thead>
<tr>
<th>Basis</th>
<th>Successes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemiology of chronic diseases</td>
<td>Differences in the pathogenic mechanisms of asthma and allergies greater than suspected</td>
</tr>
<tr>
<td>Genetic epidemiology</td>
<td>Elucidation of the genetic causes of chronic diseases such as diabetes, allergies or cardiovascular diseases</td>
</tr>
<tr>
<td>Environmental epidemiology</td>
<td>Relationship between birth weight and type 2 diabetes risk</td>
</tr>
<tr>
<td>Health economics</td>
<td>Multimorbidity and successful aging</td>
</tr>
<tr>
<td></td>
<td>Behavioral problems in children in connection with early exposure to tobacco smoke</td>
</tr>
<tr>
<td></td>
<td>Influence of fine particulate on cardiovascular diseases</td>
</tr>
<tr>
<td></td>
<td>Costs of overweight, smoking and environmentally related health disorders</td>
</tr>
<tr>
<td></td>
<td>Quality of life of the general population and of patients with heart disease and diabetes</td>
</tr>
</tbody>
</table>

#### New Approaches to Therapy

| Gene variants for Lipid metabolism and diabetes | Gene variants explain function of beta cells |

#### New Diagnostic Methods

| Gene markers for the early detection of diseases | Genetically caused reduced lung function increases susceptibility for chronic lung diseases |
| Gene markers for hemochromatosis | Combined genetic and phenotypic screening is the most cost-effective |

#### New Prevention Strategies

| Combination of genome-wide association studies with metabolomics | Identification of risk patients for disturbances of the metabolism |

#### Healthcare Research

| Analysis of disease management programs | Use of disease management programs (DMPs) improves the healthcare process and partially also the patients’ outcome |
| Diabetes and social imbalances | Training improves therapy participation of diabetics |
| Influence of mental state/depression on the course of disease | |

### Partnerships in Population-Based Studies

#### Partnerships

- **Partner in the National Genome Research Network NGFN-Plus**: NGFN-Plus is a large-scale biomedical research program to systematically analyze the molecular relationships and to combat diseases which are important to society. In addition, Helmholtz Zentrum München is a partner in numerous **Europe-wide research networks**, such as:
  - **BBMRI**: a biobank network to provide a common European infrastructure, technologies and resources for biobanks
  - **Engage**: a European network for the integration and harmonization of data from large population-based studies
  - **ILCOO**: a network with the common goal of elucidating gene-environment interactions in the pathogenesis of lung cancer
  - **HISCREENDIAG**: a Europe-wide network to build a tool to evaluate and improve health investments in screening and diagnosis of disease

#### Networks in Munich

In the Munich center for health sciences Helmholtz Zentrum München, in cooperation with **Ludwig-Maximilians-Universität (LMU)**, investigates the causes of health and disease and the structures, function and processes of healthcare. Also together with LMU, Helmholtz Zentrum München operates the **Genetic Epidemiological Methods Center**. It supports clinical researchers in study design and data collection and analysis. In the **research network KORA-Age**, Helmholtz Zentrum München, together with the two Munich elite universities, investigates the bases for successful aging.

#### Project Funding

Projects in the competence networks Obesity, Diabetes and Atrial Fibrillation – interdisciplinary research networks to achieve a better understanding of the underlying disease mechanisms and to develop new approaches to diagnostics and therapy

**Numerous projects funded by the German Research Foundation (DFG), the Federal Ministry of Education and Research and by the European Union**
Compact: Helmholtz Zentrum München in numbers Research at Helmholtz Zentrum München: 33 institutes and independent research units; 20 technology platforms; 2 translational research centers; 13 clinical cooperation groups; 8 junior research groups 1879 staff members: 607 scientists and post-docs; disciplines of the scientists: biology 41%, chemistry/biochemistry 14%, physics/biophysics 10% and medicine 7%; 430 doctoral students, of these 307 employed at Helmholtz Zentrum München; 824 technical staff and other employees; 46 trainees; 95 work-students, interns, temporary employees; 33% of positions are financed through third-party funds; 77% of employees in scientific area, 14% in the technical area, 9% in the administration (as of January 31, 2011) Finances: Total budget 173 million euros: 120 million euros from the Federal Government and the Free State of Bavaria; financing ratio 90:10; over 50 million euros in third-party grants (as of January 31, 2011)

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