

## The Nord-Trøndelag Health Study (HUNT)

HUNT is one of the largest and most comprehensive population-based health surveys ever performed. HUNT is a unique databank of personal and family medical histories, clinical measurements, exposure variables and biological material collected in three consecutive studies from 1984–2008. In total, more than 100,000 persons from the County of Nord-Trøndelag in Norway have participated.

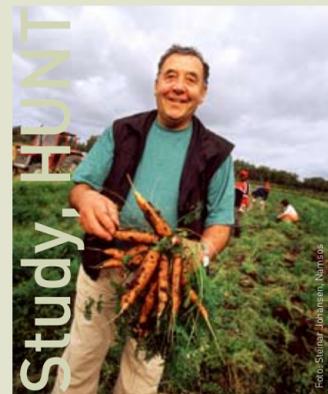
**HUNT collaborates with national and international research groups on some of the most important health challenges facing our world today, such as diabetes, cancer, musculoskeletal disease, mental illness, migraine, prostate problems, urinary incontinence, reproduction, weight and cardiovascular disease.**

### Built on trust

The fundamental strategy of HUNT is to earn and maintain the confidence of the population we work in and with. This strategy has been successful and has resulted in extraordinarily high participation rates. There is enthusiastic public and political support for HUNT and for the HUNT Research Centre. This has created a good basis for further health surveys in the County and an excellent research environment.

### Extensive data

The HUNT studies have compiled extensive medical, lifestyle and environmental data associated with each biological sample, comprising in total about 800 exposure variables and nearly 3000 different variables per individual. These datasets allow for prospective correlations to be made between genetic, epigenetic, lifestyle, environmental and health/disease profiles. Through an individual personal identifier (PIN) linkage to registries at the national level can be established to access additional information. Participants have provided very detailed information through the HUNT surveys. This has been validated in several studies based on HUNT data and has greatly contributed to the overall value of the HUNT Biobank for research projects.



The Nord-Trøndelag Health Study, HUNT

## Contact information

HUNT Research Centre is part of the Faculty of Medicine at the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. HUNT Research Centre is located in Verdal in the County of Nord-Trøndelag.

Read more: [www.hunt.ntnu.no](http://www.hunt.ntnu.no)

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## Selected publications

Close to 500 publications and 40 PhD's, based on HUNT data, are an important part of our scientific output.

Dale AC, Vatten LJ, Nilsen TI, Midtjell K, Wiseth R. Secular decline in mortality from coronary heart disease in adults with diabetes mellitus: cohort study. *BMJ*. 2008 Jul 1;337:a236.

Rayjean J. Hung, James D. McKay, Valerie Gaborieau, et al. A genome-wide association study identifies a susceptibility locus for lung cancer encompassing nicotine acetylcholine receptor subunit genes at 15q25. *Nature*. 2008 Apr 3;452(7187):633-7

Eleftheria Zeggini, Laura J Scott, Richa Saxena, Benjamin F Voight, Jonathan L Marchini Tianle Hu, Paul IW de Bakker et al. . Metanalysis of genome-wide association data and large-scale replication identifies additional new susceptibility loci for type 2 diabetes. *Nature Genetics* 40, 638 - 645 (2008). Published online: 30 March 2008

Johansson S, Raeder H, Eide S, Midtjell K, Hveem K, Sovik O, Molven A, Njølstad P. Studies in 3,523 Norwegians (HUNT2) and Meta-Analysis in 11,571 Subjects Indicate that Variants in the HNF4A P2 Region are Associated with Type 2 Diabetes in Scandinavians. *Diabetes*. 2007 Dec;56(12):3112-7.

Hallan S, Astor B, Romundstad S, Aasarød K, Kvenild K, Coresh J. Association of kidney function and albuminuria with cardiovascular mortality in older vs younger individuals: The HUNT II Study. *Arch Intern Med*. 2007 Dec 10;167(22):2490-6.

Mykletun A, Øverland S, Dahl AA, Krokstad S, Bjerkeset O, Glozier N, Aarø LE, Prince M. A population-based cohort study of the effect of common mental disorders on disability pension awards. *Am J Psychiatry*. 2006 Aug;163(8):1412-8

Aegidius K, Zwart JA, Hagen K, Schei B, Stovner LJ. Oral contraceptives and increased headache prevalence: the Head-HUNT Study. *Neurology* 2006; 66: 349-353

Krokstad S, Westin S. Disability in society. Medical and non-medical determinants for disability pension in a Norwegian total county population study. *Soc Sci Med* 2004;58:1837-48

Romundstad S, Holmen J, Hallan H, Kvenild K, Ellekjaer H. Microalbuminuria and all-cause mortality in treated hypertensive individuals: does sex matter? The Nord-Trøndelag Health Study (HUNT), Norway. *Circulation* 2003; 108: 2783-2789

Nilsson M, Johnsen R, Ye W, Hveem K, Lagergren J. Obesity and estrogen as risk factors for gastroesophageal reflux symptoms. *JAMA* 2003; 290: 66-72

Rørtvet G, Daltveit AK, Hannestad YS, Hunsår S. Urinary incontinence after vaginal delivery or cesarean section. *N Eng J Med*. 2003 Mar 6;348(10):900-7



# The Nord-Trøndelag Health Study (HUNT), Norway

NTNU  
Faculty of Medicine

## HUNT 1-2-3

In 1984, a population-based health study was launched in the central Norwegian region of Nord-Trøndelag. The study was intended to stimulate epidemiological research and to provide a new basis for clinical and preventive medicine projects. The study was named the HUNT Study.

The County of Nord-Trøndelag has a scattered rural population of about 130,000, which can be characterized as stable and homogeneous. Urban centres are small, with fewer than 25,000 inhabitants, and the population is served by two well-established local hospitals. To date, three surveys have been completed.

The HUNT1 study (1984–1986) recruited 75,000 participants above 20 years of age, with no upper age limit. The participation rate was 88 %, a remarkable result in national and international terms. The survey was based on questionnaires and clinical examination, a capillary glucose test was taken, but no biological samples were stored.

The HUNT2 study (1995–1997) comprised 74,000 participants, once again achieving a very high participation rate of 72 %. The age group between 13 and 19 was included in a sub-study called *YoungHUNT*. In addition to questionnaires and clinical examination, 65,000 blood samples (serum, whole blood) were collected from all participants aged 20 or older, resulting in the current collection of purified DNA material.

The HUNT3 study (2006–2008) was completed in June 2008 with an attendance rate of close to 60 %, comprising about 60,000 participants, including the *YoungHUNT* sub-study. The study introduced a strict protocol for collection, sample handling and storing of blood samples, thus ensuring biological samples of optimal quality.

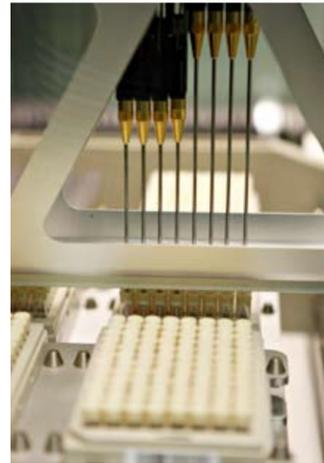
### Covering more than 20 years

HUNT offers unique opportunities for longitudinal studies, given that 46,000 individuals participated in both HUNT1 and HUNT2, covering a period of 10 years. Of these, 27,000 have also participated in HUNT3, allowing for 20 years of longitudinal follow-up. In HUNT 3, 37,000 of the participants in HUNT2 were re-examined.

The combination of health data and biological material with a very large number of other exposure variables, is ideal for studies of interactions between genetic variation, lifestyle and environmental factors. The value of HUNT lies also in the possibility of linking to well-classified phenotypic information sources, such as local and national disease registries.



*YoungHUNT: In 1995, YoungHUNT was established covering the age group from 13 to 19 with an attendance rate of 90 % of the invited.*



The homogeneous and stable population of Nord-Trøndelag in Norway is a unique source of health information and biological material

## HUNT Biobank and the National CONOR Biobank

HUNT Biobank is one of the most modern and extensive international biobanks, storing whole blood and DNA from 200,000 individuals, serum and plasma samples from more than 100,000 individuals as well as urine, RNA tubes, cells, buffy coat and Na-heparin tubes for environmental analysis for as many as 50,000 individuals.

All bio-specimens from the HUNT surveys are collected, processed and stored at the HUNT Biobank in Levanger, which was officially opened in March 2007. The Biobank is a new laboratory and storage facility (2000 m<sup>2</sup>) specially designed for the purpose and equipped with state-of-the-art infrastructure, including a fully automated DNA storage facility, in which all samples are stored at the appropriate temperature.

The National CONOR Biobank is located on the same site, where it serves as a central research repository for DNA samples from all the largest Norwegian health surveys. These make up "the Cohorts of Norway" (CONOR), which include samples from more than 200,000 individuals.

### International collaboration and ongoing studies

The HUNT databank provides data on a large number of diseases observed in the general population. The data have been utilized in more than 250 ongoing or completed research projects, with particular emphasis on major disease areas such as diabetes type 2, cardiovascular, kidney and pulmonary disease, and bone density - as well as in studies on urine incontinence, haemochromatosis, reflux disease/dyspepsia, thyroid disease, headache and skeletal muscular complaints, anxiety and depression.

HUNT is an integral part of several EU projects in the Sixth and the Seventh Framework Programme and its role in EU-funded health research is expected to be further extended in years to come. HUNT also participates in major collaborative transatlantic projects funded by the National Institutes of Health (NIH) and the National Cancer Institute (NCI).

HUNT has cooperated actively with the UK Biobank, on the basis of a bilateral national agreement signed in 2005, including the development of integrated solutions for data management and automated sample handling.

In 2007, NTNU and the International Agency for Research on Cancer (IARC/WHO) signed a memorandum of understanding promoting cancer research, based on HUNT studies.

HUNT Biobank is also collaborating with partners in India to establish population-based health cohorts and biobanks.

## HUNT Biosciences Ltd

HUNT Biosciences Ltd is the commercial arm of the HUNT Biobank and CONOR. HUNT Biosciences was established in 2007 in order to offer a professional interface with industry and facilitate commercial use of HUNT data, without compromising the trust of the donor population. HUNT Biosciences is publicly owned, and any profits made by the company will be returned to the community as a financial basis for further research.

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## HUNT phenotype, genotype and environmental data support R&D for major disease areas such as:

<p><b>Phenotype/medical data:</b></p> <ul style="list-style-type: none"> <li>Medical examination results include height, weight, waist/hip ratio, Body Mass Composition, blood pressure and heart rate</li> <li>Serum values including total cholesterol, HDL, triglycerides and glucose</li> <li>Family medical history include data on diabetes and cardiovascular disease among relatives</li> <li>Glucose tolerance test for all those at risk for diabetes</li> <li>Self-reported health and disease status</li> <li>Crosslink with clinical records and local end-point registries via local hospitals</li> <li>Medication via Prescription registry</li> </ul>	<p><b>Lifestyle &amp; environmental data:</b></p> <ul style="list-style-type: none"> <li>Data on smoking, alcohol consumption and drug consumption</li> <li>Physical activity</li> <li>Personal circumstances</li> <li>Housing</li> <li>Employment</li> <li>Local environment</li> </ul>
<b>Diabetes &amp; Obesity</b>	
<p><b>HUNT Diabetes Project:</b></p> <ul style="list-style-type: none"> <li>Specific questionnaire</li> <li>Individual follow-up study with interventions</li> </ul>	<p><b>Genotype information:</b></p> <ul style="list-style-type: none"> <li>DNA samples for analysis</li> <li>Extensive genotyping results will be available from an increasing number of samples in the HUNT Database</li> <li>Infrastructure for replication studies in place</li> <li>In-house genotyping facility</li> </ul>

<p><b>Phenotype/medical data:</b></p> <ul style="list-style-type: none"> <li>Medical examination results incl. height, weight, waist/hip ratio, Body Mass Composition, blood pressure and heart rate</li> <li>Serum values including Total cholesterol, HDL, Triglycerides and Glucose</li> <li>Self-reported health and disease status</li> <li>Medication from Prescription Registry</li> </ul>	<p><b>Lifestyle &amp; environmental data:</b></p> <ul style="list-style-type: none"> <li>Data on smoking, alcohol and drug consumption</li> <li>Physical activity</li> <li>Personal circumstances</li> <li>Housing</li> <li>Employment</li> <li>Local environment</li> </ul>
<b>Arthro-sclerosis &amp; Thrombosis</b>	
<p><b>Link to local endpoint registries:</b></p> <ul style="list-style-type: none"> <li>Venous Thromboembolism with 750 retrospective cases from 1996–2000, and new cases from 2000–2007 to be added.</li> <li>Myocardial Infarction with 300–350 incident cases/year, retrospectively for 1996–2000 and prospectively from 2001</li> </ul>	<p><b>Genotype information:</b></p> <ul style="list-style-type: none"> <li>DNA samples for analysis</li> <li>Extensive genotyping results will be available from an increasing number of samples in the HUNT Database</li> <li>Infrastructure for replication studies in place</li> <li>In-house genotyping facility</li> </ul>

<p><b>Phenotype/medical data:</b></p> <ul style="list-style-type: none"> <li>Results from clinical examination and serum analysis</li> <li>Family medical history</li> <li>Crosslink with National Registries</li> <li>Crosslink with clinical records and local end-point registries via hospitals</li> <li>Information on medication via National prescription registry</li> <li>Serum samples available for additional analyses</li> <li>Longitudinal data covering more than 20 years</li> </ul>	<p><b>Lifestyle &amp; environmental data:</b></p> <ul style="list-style-type: none"> <li>Data on smoking, alcohol and drug consumption</li> <li>Physical activity</li> <li>Personal circumstances</li> <li>Housing</li> <li>Employment</li> <li>Local environment</li> </ul>
<b>Biomarker discovery and validation</b>	
<p><b>Subprojects collecting detailed disease specific information</b></p> <ul style="list-style-type: none"> <li>Disease-focused questionnaires</li> <li>Individual follow-up study with interventions (e.g. diabetes)</li> </ul>	<p><b>Genotype information:</b></p> <ul style="list-style-type: none"> <li>DNA samples for analysis</li> <li>Extensive genotyping results will be available from an increasing number of samples in the HUNT Database</li> <li>Infrastructure for replication studies in place</li> <li>In-house genotyping facility</li> </ul>

<p><b>Phenotype/medical data:</b></p> <ul style="list-style-type: none"> <li>Results from clinical examination and serum analysis</li> <li>Family medical history incl. cancer cases</li> <li>Crosslink with National Cancer Registry</li> <li>Crosslink with clinical records via local hospitals</li> <li>Information on medication via National prescription registry</li> <li>Serum samples available for additional analyses</li> <li>Longitudinal data covering more than 20 years</li> </ul>	<p><b>Lifestyle &amp; environmental data:</b></p> <ul style="list-style-type: none"> <li>Data on smoking, alcohol and drug consumption</li> <li>Physical activity</li> <li>Personal circumstances, housing and employment</li> <li>Local environment</li> <li>More than 800 exposure variables</li> </ul>
<b>Oncology</b>	
<p><b>HUNT3: subprojects for specific cancers</b></p> <ul style="list-style-type: none"> <li>Questionnaires for breast, prostate and colorectal cancer</li> <li>Links to clinical biobanks collecting tissue samples of HUNT participants that developed cancer</li> </ul>	<p><b>Genotype information:</b></p> <ul style="list-style-type: none"> <li>DNA samples for analysis</li> <li>Extensive genotyping results will be available from an increasing number of samples in HUNT Database</li> <li>Infrastructure for replication studies in place</li> <li>In house genotyping facility</li> <li>Access to tissues possible via clinical biobanks</li> </ul>