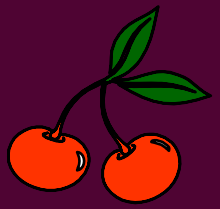
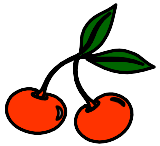
The Swedish Twin Registry (STR)



History



- Started by Lars Friberg and Rune Cederlöf in the late 1950s
- Church records of twin births 1886-1925
- All identified same sex twins contacted during the 1960s
- Today, all Swedish born twins aged 9 months or 9 years are contacted and asked for participation
- Study-based collections, in common:
  - → Nationwide
  - → Whole birth cohorts
  - → Swedish-born
  - → Personal number – persistent pair ID and twin ID

STR leadership and organization

Steering Committee

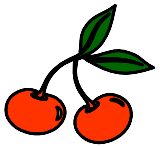
- **Catarina Almqvist** Malmros, chair, Karolinska Institutet (KI)
- **Anna Bennet Bark**, Health and Social Care Inspectorate
- **Anna Beskow**, Uppsala University
- **Bo Jacobsson**, University of Gothenburg (GU)
- **Christer Jansson**, Uppsala University
- **Henrik Larsson**, Örebro University
- **Cecilia Magnusson**, KI

Expert Group

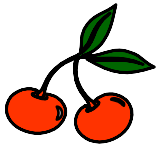
- **Sara Hägg**, chair, KI
- **Johan Askling**, KI
- **Sofia Carlsson**, KI
- **Fang Fang**, KI
- **Paul Lichtenstein**, KI
- **Nancy Pedersen**, KI
- **Sebastian Lundström**, Representative from the STR National Council, GU

National Council

- Karolinska Institutet
- Lund University
- University of Gothenburg
- Örebro University
- Jönköping University
- Umeå University
- GIH
- Linné University

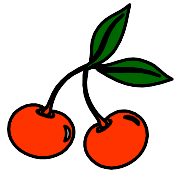


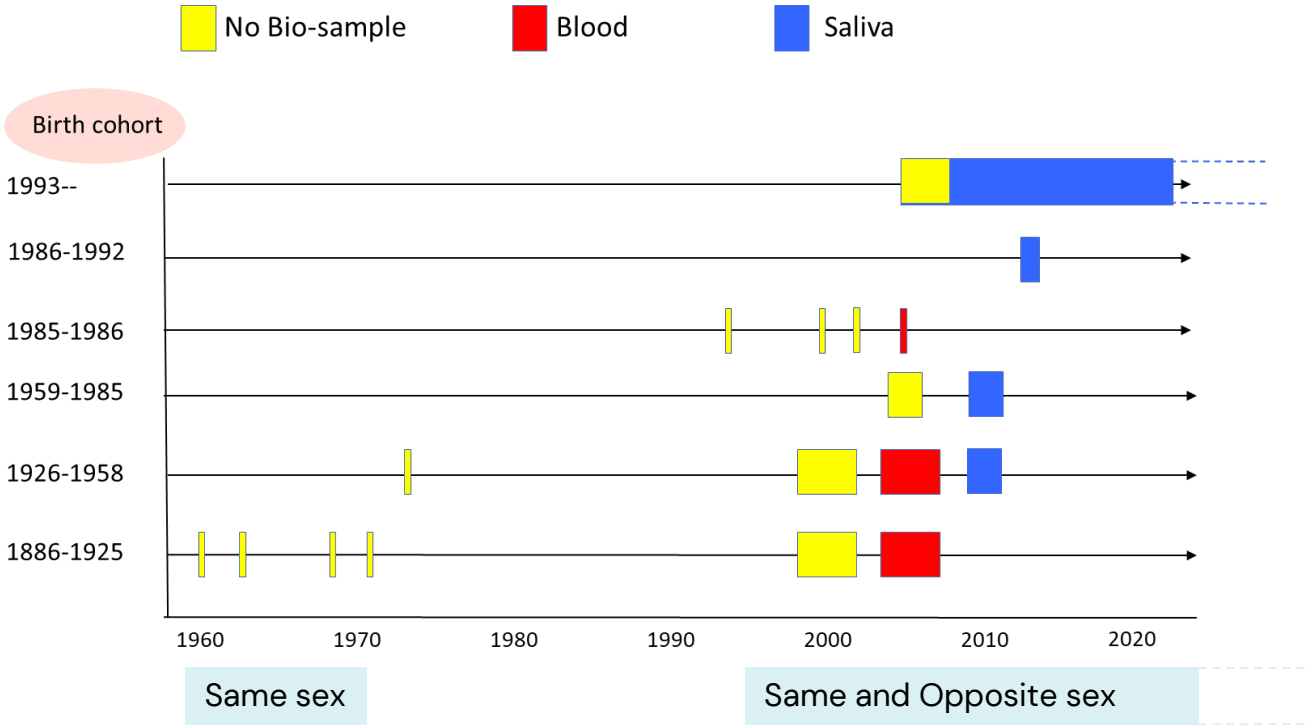
Funding



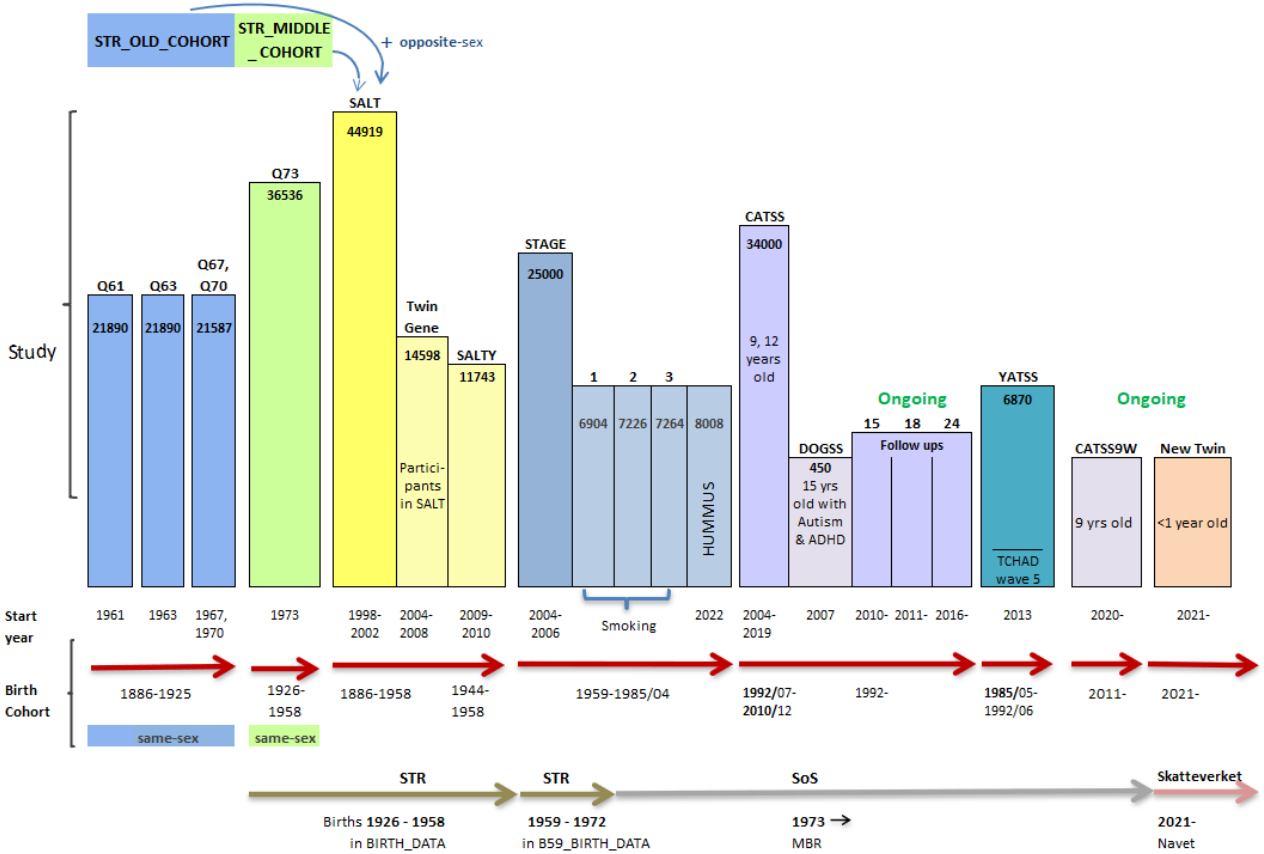
- Financial support from KI as core facility
- Grant from the Swedish Research Council as a national infrastructure
  - → 2018-2022, grant no 2017-00641
  - → 2023-2028, grant no 2021-00180

Full-cohort contacts for data and bio-sampling



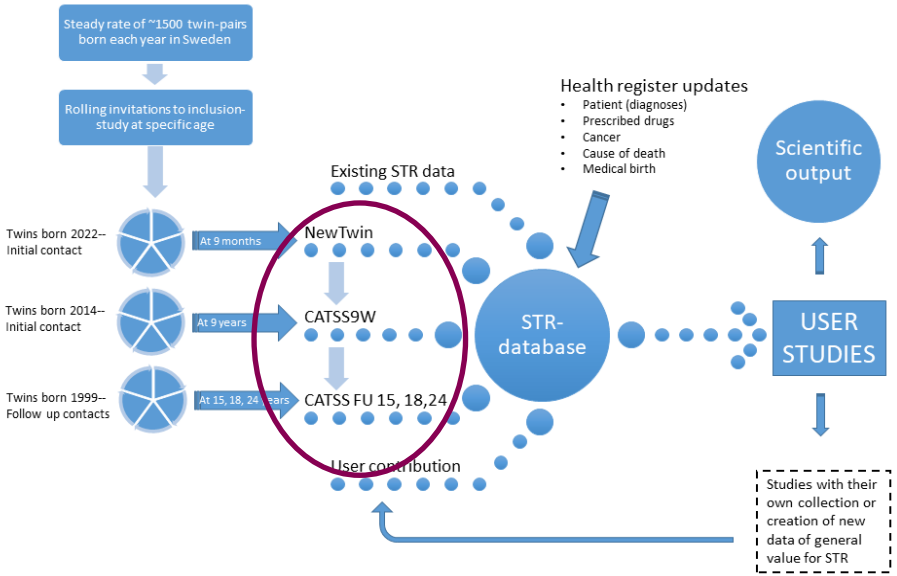


STR Study Overview



Inclusion of new twins in STR

- Twins are identified through the Swedish Tax Agency (Skatteverket) and the Medical Birth Register
- The guardians are first contacted with a request to allow the twins to participate when the twins are either 9 months or 9 years old
- Broad consent – to study somatic and mental health problem
- Data collection - questionnaires, saliva (DNA) and health register data
- Follow-ups at 15, 18 and 24 years
- Response rate steady at 50%



How to use the STR

Data

- → Zygosity
- → New contacts and data collection (subscription)
- → STR internal data: questionnaire data and health register linkage until 2016
- → Linkage to other national registers or data sources available for research
- → GWAS (N=50,000)
- → Proteomics:
  - Charité (N=12,000)
  - OLINK oncology (N=7,000, same-sex pairs)
- → Serum (N=12,600)
- → DNA (60,000)

Methods

- → Classic twin-based variance decomposition models (heritability etc.)
- → Co-twin control association studies (discordant twins)
- → Ordinary epidemiological associations studies (incl GWAS)
- → Within twin-pair association studies (incl sibling GWAS)

Access to data and samples

- → Requests are evaluated by the expert group four times per year – sustainability and secrecy test (menprövning)

Available data

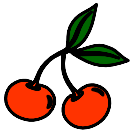


Table 1. Available data content in the STR (not including NewTwin)

Type of data	N (thousands individuals)	Birth years covered
Identity (personal number)	214	1886-2015
Self-report questionnaires*	131	1886-2004
Parental report questionnaires*	36	1992-2011
Zygosity	180	1889-2011
DNA	58	1911-2011
GWAS	51	1911-2011
Whole genome sequencing	1	1911-1958
Serum	15	1911-1958
Nightingale Metabolomics	12	1911-1958
Blood biochemistry	15	1911-1958
ICD hospital diagnoses (at least one)	140	1886-2008
Prescriptions (at least one)	118	1900-2008
Cancer (any)	24	1886-2008
Deaths	49	1886-2008
Cause of death	44	1886-2008
Conscription (males)	24	1936-1979
Birth-data (the child is a twin)	134	1926-2008
Birth-data (the mother is a twin)	24	1927-1998

* searchable in strdata.se

Genotyping – GWAS (Illumina)

- Older twins, born 1911–1958:
  → **N = 20 000**
- Middle age twins born 1959–1993
  → **N = 13 300**
- Younger twins, born in 1992 or later (ongoing)
  → **N = 17 000**

Genotyped in batches at SNP&SEQ Tech, Uppsala between 2008–2024

Serum measurements

All participants of the TwinGene (N=12,600)

- HDL, LDL, TC, TG, CRP, Hb, HbA1c, Glucose, ApoA1, ApoB
- ACPA (Lars Klareskog)
- Total IgA (Lennart Hammarström)
- Creatinine, Cystatin C (Per Svensson)
- Pepsinogen I/II, H. pylori (Weimin Ye)
- Metabolomics (Nightingale)
- Proteomics (Charité)

Subsets

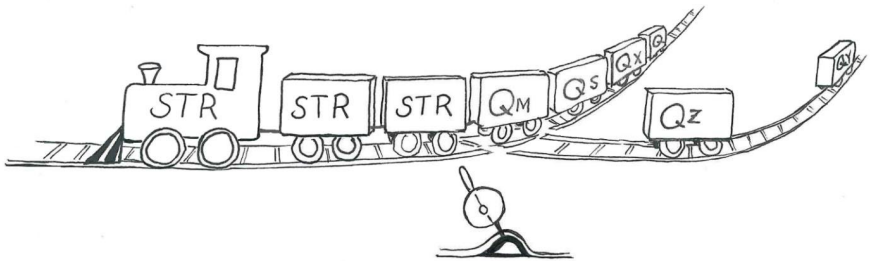
- LpPla2, aPC, aOxCl (Ulf de Faire, Johan Frostegård)
- PCSK9, APOC3, insulin (Ferdiand Van T Hooft)
- Proteomics (SciLife Lab Protein atlas)
- Metabolomics (HPLC Mass spec)
- Oncology panel (OLINK)

Services in iLab

STR uses iLab for managing requests

- Feasibility test
- Application and data withdrawal:
  - → Amendment
  - → Genotypes
  - → Biosamples (serum, DNA)
  - → Addresses
- Subscriptions

Subscription – Add your items in onward studies



Research areas of ongoing subscriptions

- ADHD och Autism
- Eating disorders
- Allergy and Asthma
- OCD
- Diet and nutrition
- Premenstrual disorders
- Synesthesia and Aphantasia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