



# Twin Registers: The Danish Twin Registry



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# A Twin Register is...

**Collection of individuals from multiple births ...**

## **Register:**

- Longitudinal dimension - maintenance
- Continued follow-up

## **Purpose:**

- Provide basis for studies to disentangle the importance of genetic, familial and environmental factors on life events, health conditions and diseases



# Types of Twin Registers

- **Local registers vs. national registers**
- **Specific vs. general**
  - Focus on a specific phenotype
  - Wide range of phenotypes
- **Population-based vs. Disease-based**



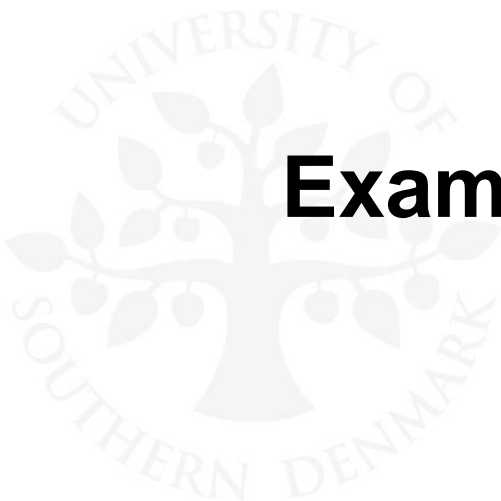


# How To Ascertain Twins?

**Identification**

**Tracing / Follow up**

**Example: Danish Twin Registry**





# Identification I

## Direct methods

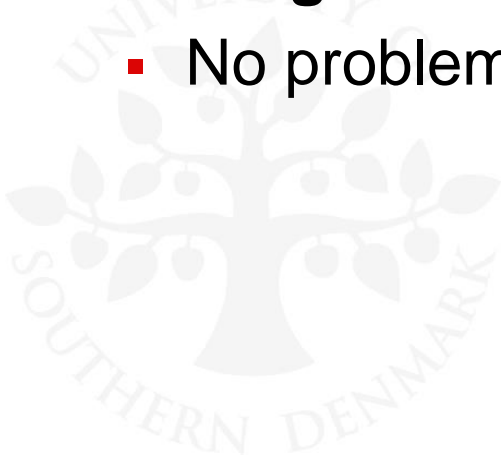
### - **Medical Birth Register**

- Select births registered as multiple births

Complete identification of both live- and stillborn children

### - **Tracing / Follow up:**

- No problem: Info from register





# Identification II

## Direct methods

- **Parish records**
  - Manually selecting children marked as twins  
Depends on marking of twin births



1920.

Nr.	Fødselsaar og Datum.	Hvor født? (Paa Landet: Byen, Sognet og Herredet. Har Gaarden eller Huset særegt Navn, bør det anføres. I Købstad: Købstaden og tillige Sognet, hvis der i Byen er mere end 1 Sogn, samt derhos altid Gaden og Husnummeret.)	Barnets fulde Navn.	Forældrenes fulde Navn efter Forevisning af Døbe- eller i alt Fald Vielsesattest eller ved Eftersyn i Kirkebogen; deres Stilling og Bopæl; samt for Moderens Vedkommende Angivelse af hendes Alder med det fyldte Aar. (Barnets ægte Fødsel maa altid dokumenteres ved Vielsesattest eller Eftersyn i Kirkebogen.)	Daabsdagen.	Hvem der har foretaget Daabs-handlingen, og om den er foretaget i Kirken eller hjemme. Ved Hjemmodaab anføres tillige Datoen for Fremstillingen i Kirken.	Fæddernes fulde Navn, Stilling og Bopæl.	Anmærkninger. (Her anføres blandt andet, hvad der vedkommer Bestemelsen af Barnets Fødehjemstedret.)
—	1920 2 Februar	Hølskrup Sogn	Poul Gelstov Røge <del>Kansen</del> *)	Ugift, Bogholderste Kugdaleen Catharine Røge Kroningsvej 4.	11 Juli 1920	Pastor Skovs & Kirken	Pige Kamille Hansen, Skolelær og Kgl. S. Røge. Odense	Moderens Børstestue formodt. 44. 1920 skolel. Hølskrup 1920
—	1920 17 April	Kjellerminde	Kai Kaal Holten Lützkehoff	Ingeniør Hans Holten Lützkehoff og Kirsten Bruun Olga Beatrix Ellen skone Tachs. Københavnvej 29.	8 Maj 1920	Kommuneaaet Fremstillet i Odense S. Knuds Kirke 10 September 1920.	Lifeprevotende Fru Helene Lützkehoff & Fru Ingeborg Johansen Skene. Købstadsfoged Svend Lützkehoff & Præsident Albert Tachs. København.	skone. gen Fødsel 1920 Født d. 13/12 20 Barnet har Fødselsjætte ret i Odense. Mødte skone i 1920
138	1920 3 Juli	Odense	St. Knuds Sogn Kongensgade 31	Redaktør Luder Valdemar Blomholt og Kirsten Edith Soderbølle Goldschmidt, Larsen. 27 Aar.				
139	1920 6 Juli	Odense	St. Knuds Sogn Garbnergade 15 <sup>I</sup>	Lærkerunde Jens Vilhelm Jensen og Kirsten skone Guldbergsgade skone 30 Aar.	8 Juli 1920	Lifeprevot Lützkehoff Kommuneaaet & Kirken 15 August 1920.	Lifeprevotende Fru Helene Lützkehoff & Fru Ingeborg Johansen Skene. Købstadsfoged Svend Lützkehoff & Præsident Albert Tachs. København.	Vest i St. Knuds Kirke 27/2 R.
140	1920 6 Juli	Odense	St. Knuds Sogn Gartnergade 15 <sup>I</sup>	Robert Hedeliund Jensen samme	8 Juli 1920	Lifeprevot Lützkehoff Kommuneaaet & Kirken 15 August 1920.	Lifeprevotende Fru Helene Lützkehoff & Fru Ingeborg Johansen Skene. Købstadsfoged Svend Lützkehoff & Præsident Albert Tachs. København.	Mødte skone i 1920.
141	1920 7 Juli	Odense	St. Knuds Sogn Kammervej 36	Forretningsfører Christian skone Sørensen Bødker og Kirsten skone 25 Aar.	3 Okt. 1920	Pastor Skovs i Kirken.	Forretningsfører skone skone Odense.	Vest i Amagers Kirke 11/12 19. Mødte 3/10 20



# Identification II

## Direct methods

- **Parish records**
  - Manually selecting children marked as twins  
Depends on marking of twin births
  
- **Tracing / Follow up:**
  - Population registers
  - Death registers
  - Relatives
  - Probate court





# Identification III

## Indirect methods

- **Use existing register information (CRS):**
  - When links between parents and children exist, select children born by same mother within few days

Note:

- Depends on the quality of the parent-child link
- Almost complete
- Stillborn children not included as well as children died before the introduction of the CRS



# Identification IV

## Indirect methods

- **Use existing register information (CRS)**

- Twins born the same day, same place and given same surname at birth =>

Select pairs who have these data in common

OBS!

- Not all selected pairs are twins
- Requires verification of twin status
- Only individuals alive at introduction of CRS can be selected



# Identification V

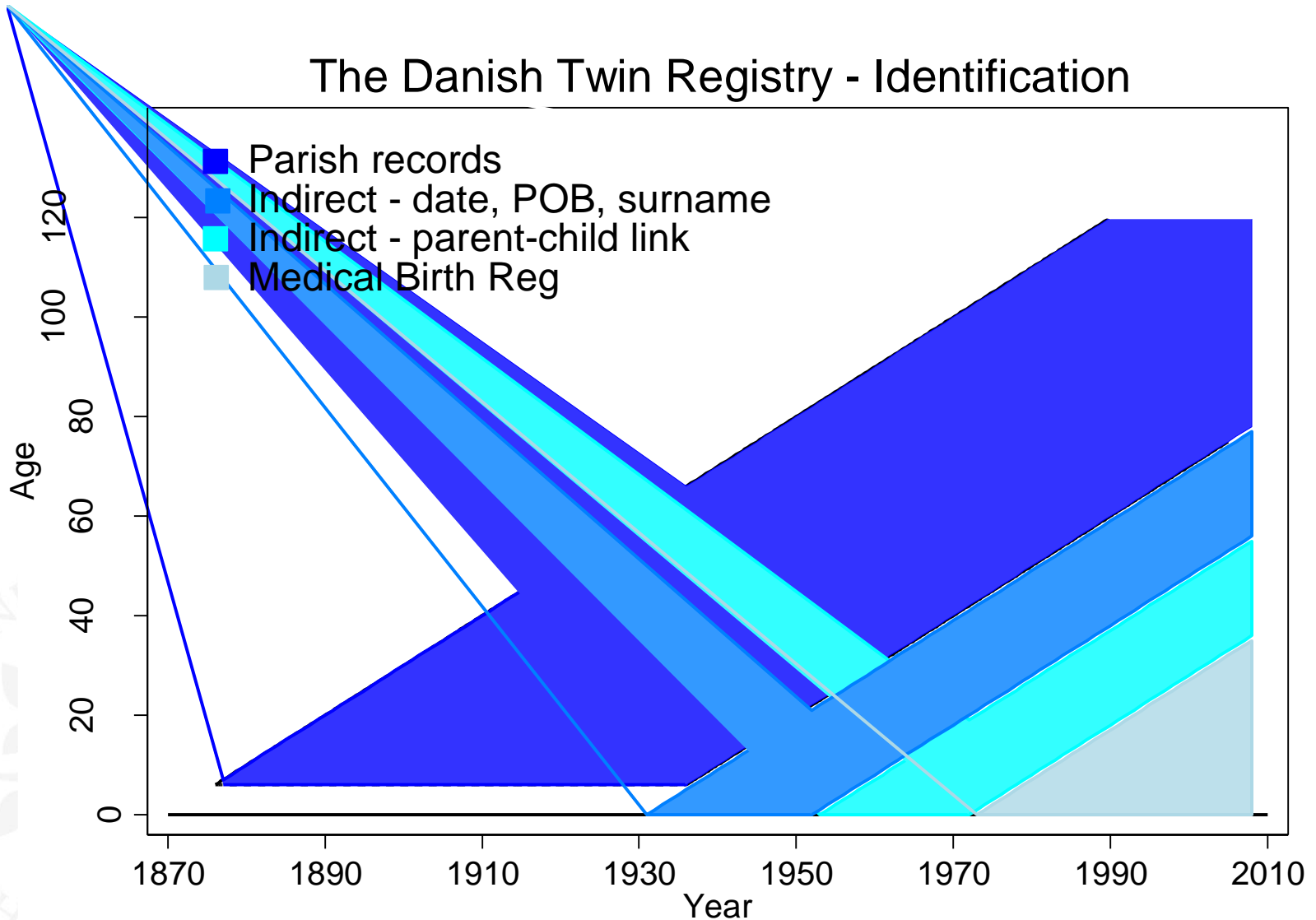
## Sporadic

- Advertisement
- Self reported twins



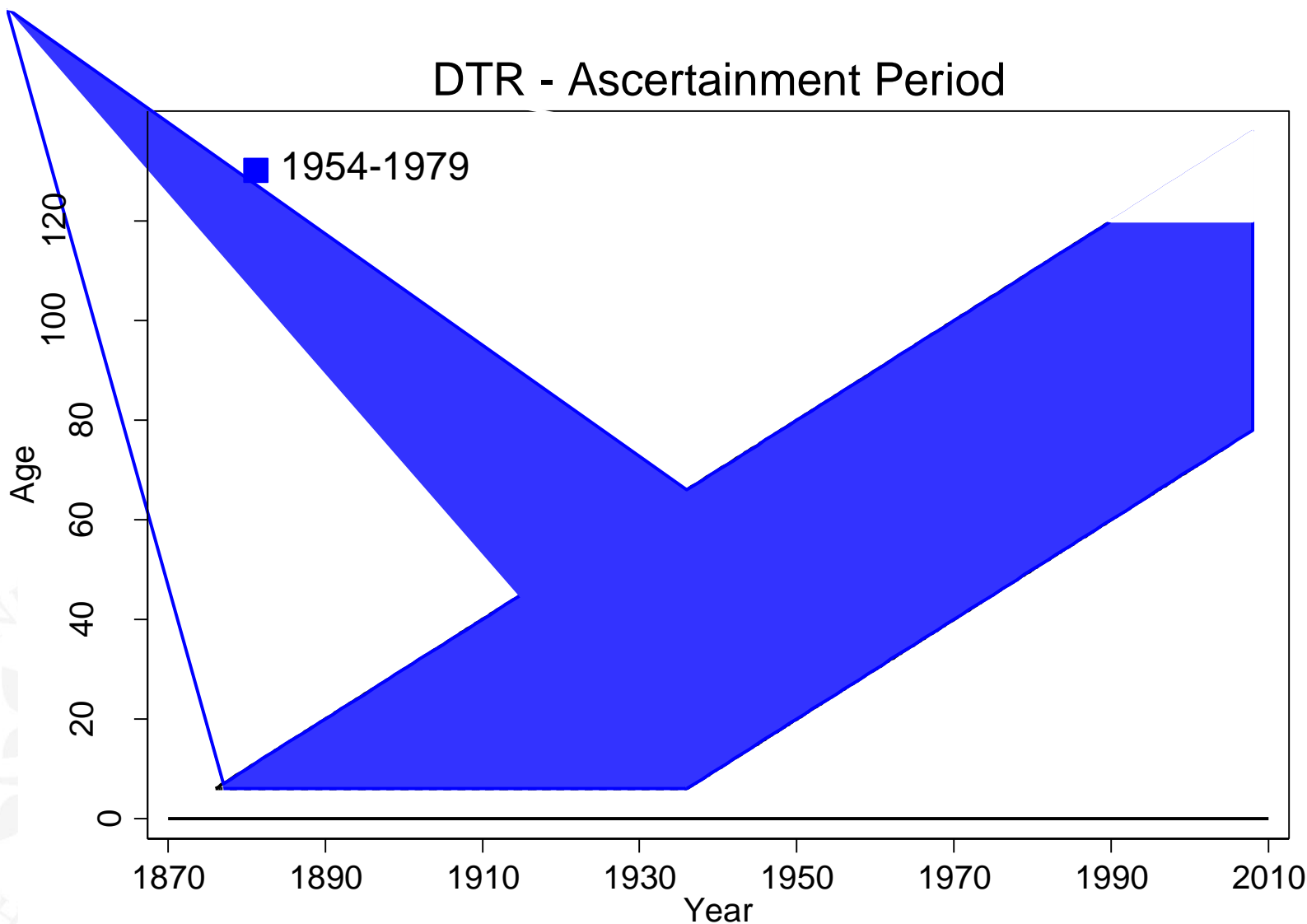


### The Danish Twin Registry - Identification



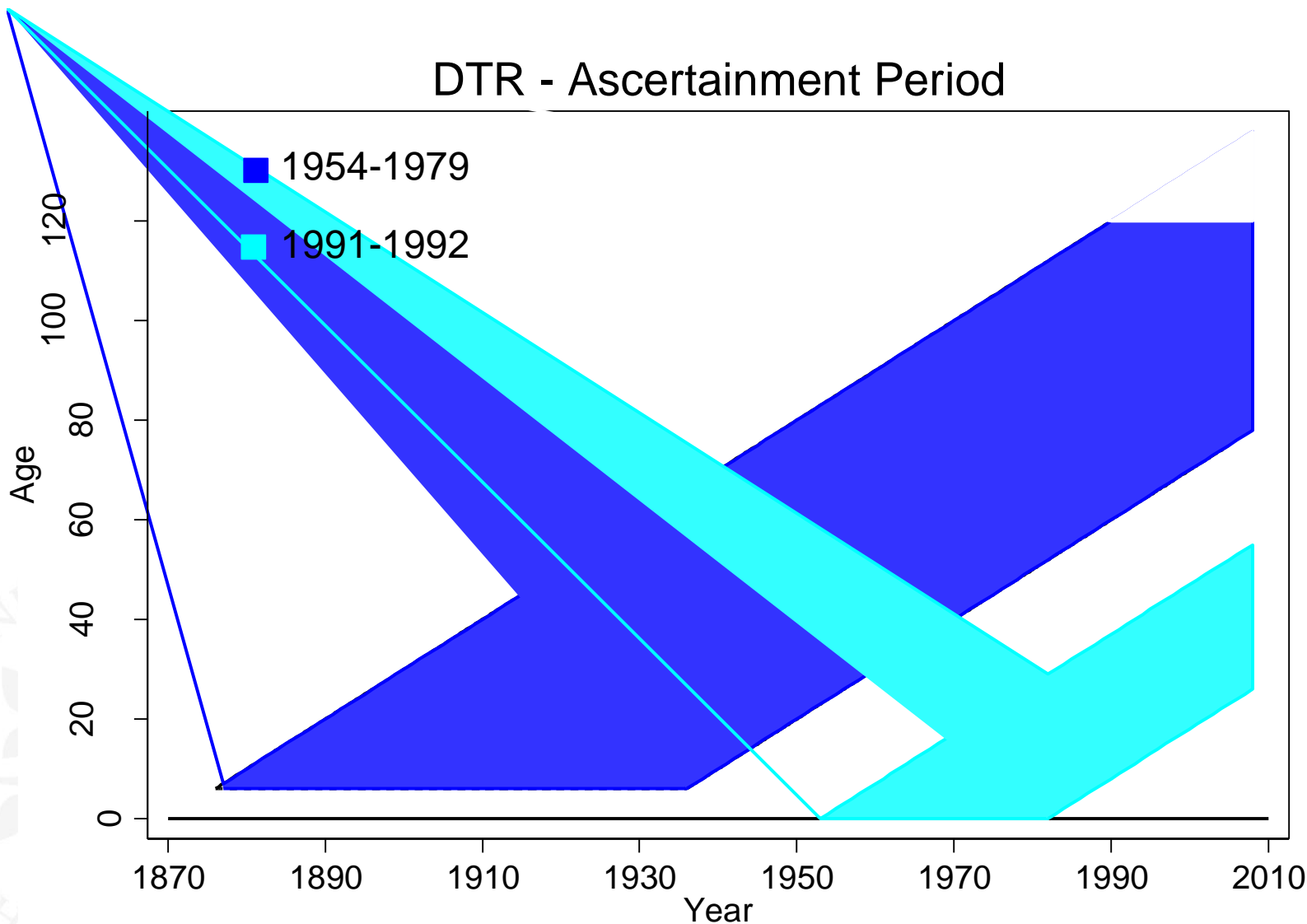


### DTR - Ascertainment Period



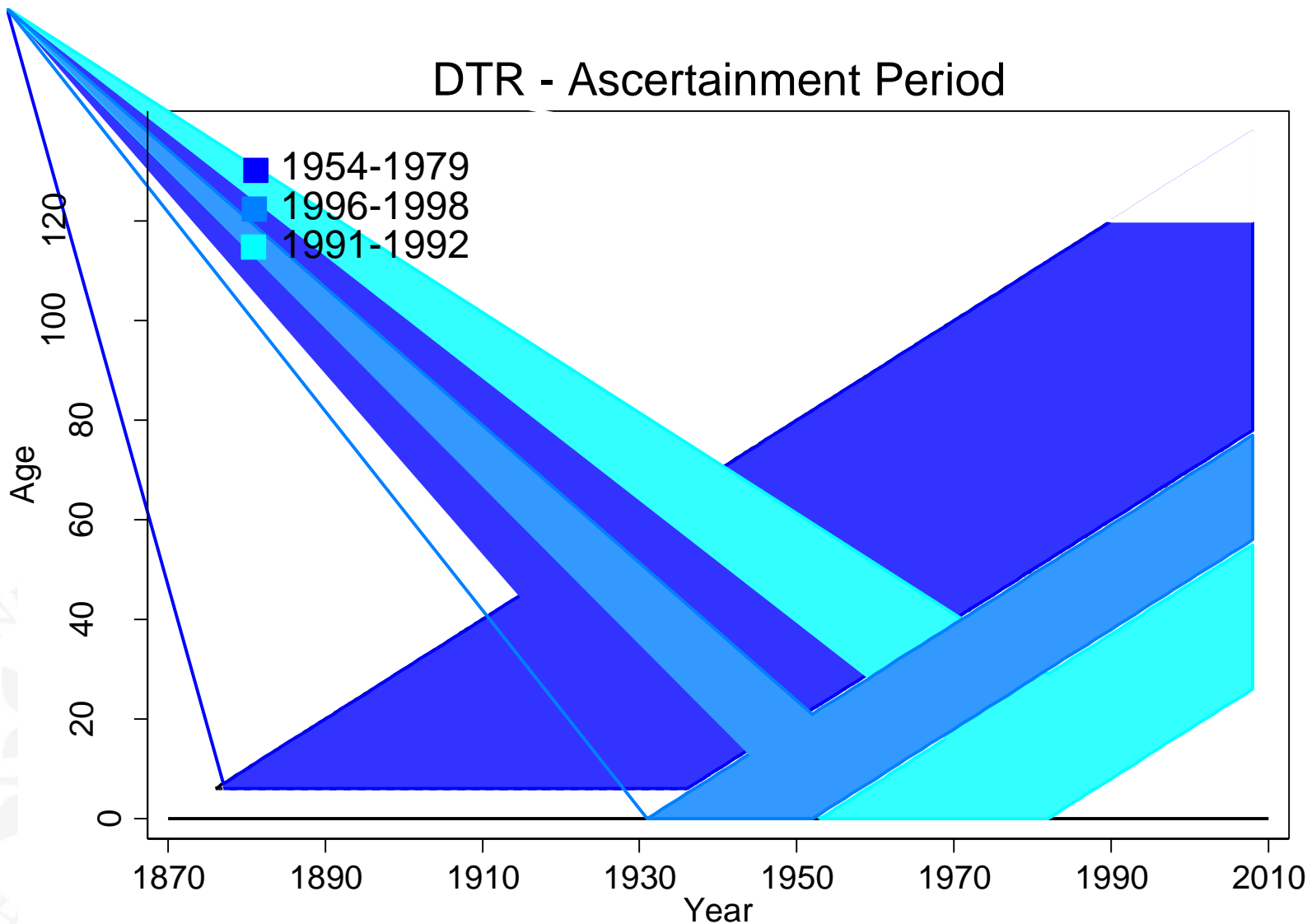


### DTR - Ascertainment Period



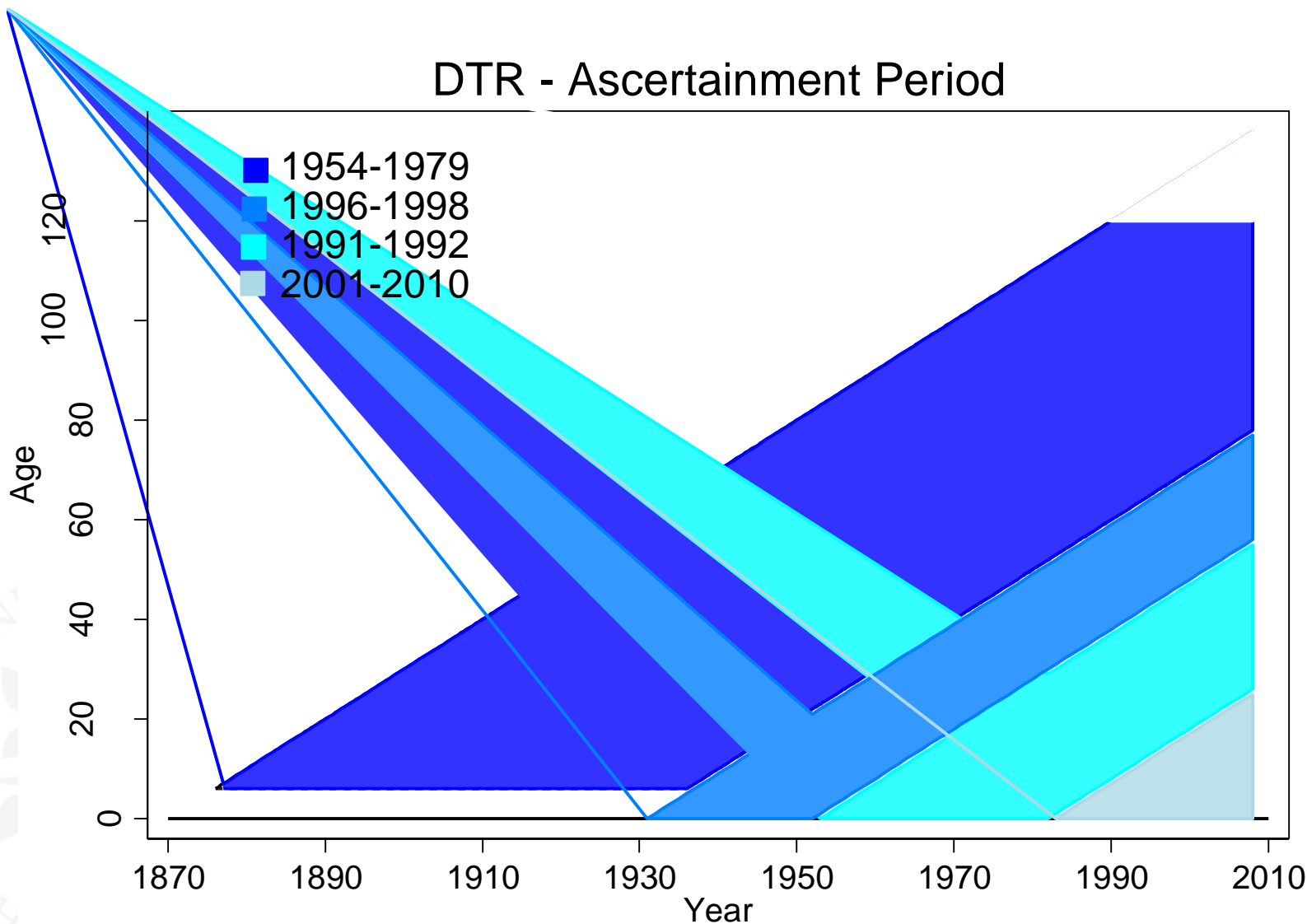


### DTR - Ascertainment Period





### DTR - Ascertainment Period







# DTR – Number of Twin Pairs - Gender

Cohort	Gender				Total	Twin pairs born
	M/M	M/F	F/F	Unknown		
1870-1910	3898	5142	4197	0	13237	<i>37914</i>
1911-1930	2948	1	3201	0	6150	<i>22700</i>
1931-1952	5928	6602	4312	239	17081	<i>24574</i>
1953-1967 <sup>#</sup>	3779	3825	3276	15	10895	<i>14332</i>
1968-1982 <sup>#</sup>	3702	2921	3362	227	10212	<i>9856</i>
1983-2000	5251	5555	4990	402	16198	<i>16195</i>
2001-2008	3429	4304	3297	83	11113	<i>11113</i>
Total <sup>§</sup>	28935	28350	26635	966	84886	<i>136684</i>

<sup>#</sup> Twin pairs born outside Denmark are included in DTR (678 twin pairs)

<sup>§</sup> In addition 775 triplets and 22 quadruplets are included in DTR



# Assesment of Zygosity

## Questionnaire method

### Similarity questions:

- ❑ 1. Do you and your twin look
  - like two ordinary siblings?
  - like two peas in a pod?
  - not very much alike?
- ❑ 2. In school, is/was it difficult for your teachers and friends to tell you apart?
- ❑ 3. Is/was it difficult for your family and friends to tell you apart?
- ❑ 4. In childhood, did you and your twin have both the same eye color and the same hair color?

## Biological material

- ❑ Serological markers
- ❑ Genetic markers



# Zygoty Assessment - Accuracy

	MZ accuracy	DZ accuracy	Total accuracy
Men (N= 342)	92% (155/169)	99% (172/173)	96% (327/342)
Women (N= 525)	96% (229/239)	96% (275/286)	96% (504/525)

Christiansen et al., *Twin Res* 2003;6:275-278



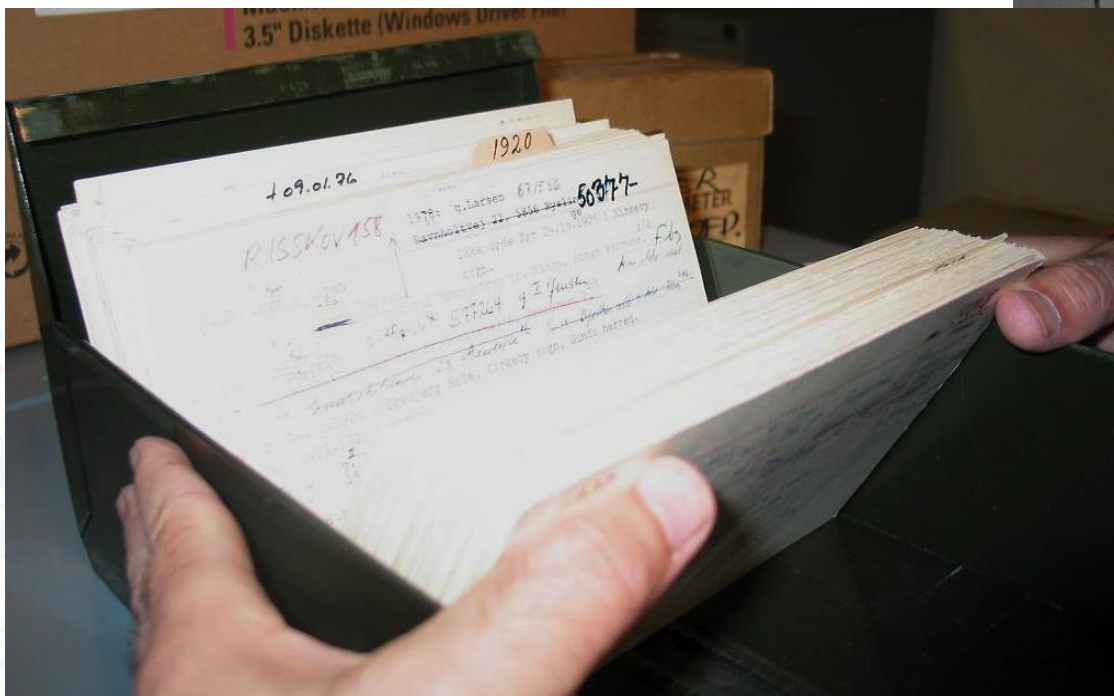


# The Old Core of DTR



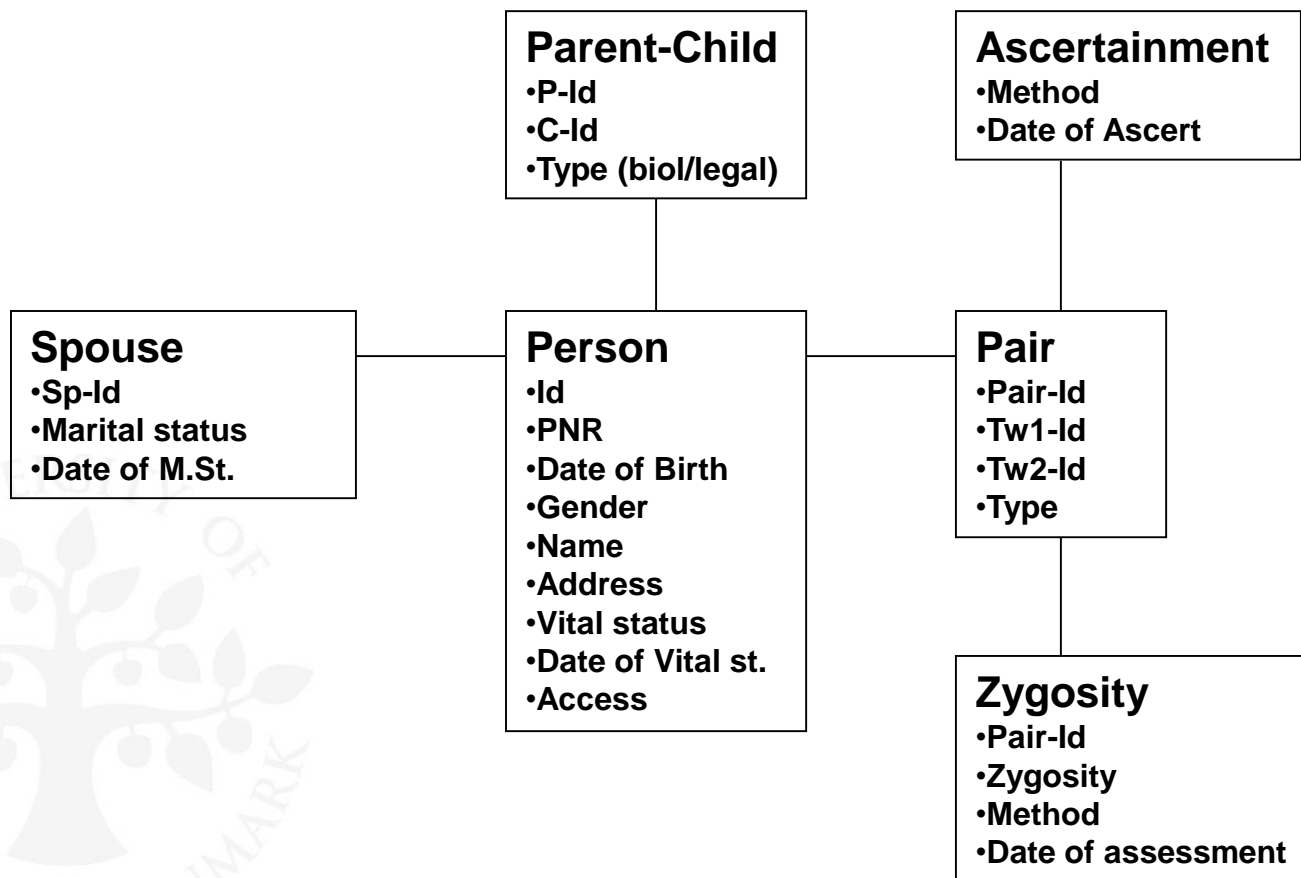


# The Old Core ...





# DTR – Present Core Data Structure





# Surveys

## Questionnaire surveys

- Large scale self-administered questionnaire surveys (1966, 1994, 2002, 2003)
- Interview-based surveys (LSADT 1995-2005, MADT 1998, MADT/MIDT 2008)

## Disease-specific surveys

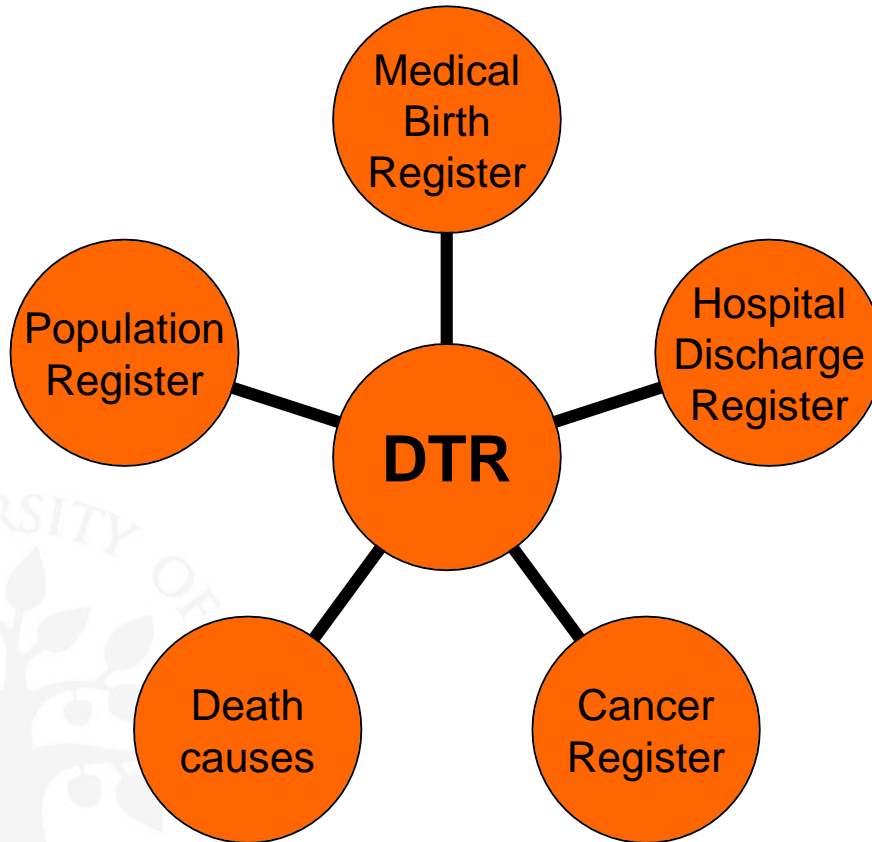
- Asthma
- Low back pain
- Epilepsy
- Arthritis

## Clinical studies

- GEMINAKAR – 1 day test program (e.g. oral glucose test, fat tolerance test, fitness, EKG, BP, blood samples, etc)



# Data from National Registers



**Requirement:**  
**Unique Personal Identification Number (PIN) used in all registers**







# Twins and Register-based Research

## Advantages

- Data exist
- Big numbers
- No dropout
- No bias
- Population-based

## Caution

- Zygosity needed
- Not all phenotypes available
- Administrative registers – not always suited for research



# Twin Registers - Examples

## Nordic & European

### □ Sweden

Birth cohorts 1886-2008

Approx. 97,000 twin pairs

### □ Norway

3 separate twin cohorts compiled at different research institutions, and each compiled with specific research agendas

Birth cohorts from 1895-1960 and 1967-

Approx. 67,000 twin pairs

### □ Finland

First cohort established 1975 from Central population register

Approx. 65,000 twin pairs

### □ Sct Thomas, UK

### □ The Netherlands Twin Register

### □ East Flanders Prospective Twin Survey

### □ Italian Twin Register