

# Risk of testicular cancer according to birthplace and birth cohort in Denmark

Charlotte Myrup, Jan Wohlfahrt, Anna Oudin, Tine Schnack, Mads Melbye

Department of Epidemiology Research, Statens Serum Institut, Copenhagen, Denmark

Based on the intriguing finding of an east-west gradient of testicular cancer risk in the Nordic countries with a low risk in Finland, intermediate in Sweden, and high risk in Denmark, it was suggested that national practices rather than individual behavior may be important in the etiology of this cancer. We investigated the risk of testicular cancer in all men born in Denmark, 1931–1969 according to birthplace. Testicular cancer information was derived from the Danish Cancer Registry and population data from Statistics Denmark. There was a several fold geographical variation in testicular cancer risk within Denmark. Among men born in the early period, 1931–39, the highest risk was primarily observed in the western part of Denmark whereas no such gradient was observed in more recent cohorts. The incidence of testicular cancer increased in all counties from the earliest to the latest birth cohort, but the increase was highest in the eastern parts of Denmark. The heterogeneity in risk according to place of birth within Denmark suggests that individual behavior plays an important role for the risk of testicular cancer. Based on the Danish data, the factor that may have caused the east-west gradient in testicular cancer risk appears to have been more unevenly distributed in the early part of the past century compared to more recent times.

Testicular cancer is believed to originate in fetal life. The scientific support for the fetal origin of testicular cancer is the finding of carcinoma *in situ* in fetal and young boys testes,<sup>1,2</sup> studies demonstrating that a carcinoma *in situ* cell is a transformed primordial germ cell,<sup>3,4</sup> and immigrant studies showing that the risk of testicular cancer is dependent on country of birth.<sup>5–8</sup> The incidence of testicular cancer differs remarkably worldwide. Even within homogeneous populations like those in the Nordic countries, substantial differences exist. Denmark and Norway have the highest incidences, with rates above 10 cases per 100,000 inhabitants (World Standard Population), whereas, the Swedish incidence is about half of this and the Finnish incidence a quarter of this. The reason for these differences is unknown but unlikely to be explained by genetic differences.<sup>9–12</sup>

The incidence of testicular cancer is usually estimated according to residence at the time of diagnosis instead of residence at the time of birth. If testicular cancer originates in fetal life, estimating incidence patterns according to residence at the time of diagnosis might lead to wrong conclusions about risk patterns within a specific geographical area, as the incidence peaks in adulthood when many may have changed their residence since they were born.

**Key words:** testicular, epidemiology

**DOI:** 10.1002/ijc.24736

**History:** Received 8 Jan 2009; Accepted 16 Jun 2009; Online 8 Jul 2009

**Correspondence to:** Charlotte Myrup, Department of Epidemiology Research, Statens Serum Institut, 5 Artillerivej, Copenhagen S, DK-2300 Denmark, E-mail: cmy@ssi.dk

The incidence of testicular cancer has increased steadily for several decades in the majority of western countries including Denmark.<sup>12–14</sup> However, the knowledge about possible differences in increase within the country borders is sparse. Exploring differences in the increase of testicular cancer within the country borders and estimating the incidence of testicular cancer according to residence at birth might add to our knowledge of testicular cancer.

Here we report the incidence of testicular cancer according to residence at birth in Denmark, 1931–1969.

## Material and Methods

The study cohort consisted of all men born in Denmark between January 1, 1931 and December 31, 1969. Information on testicular cancer status was obtained from the Danish Cancer Registry. The Danish Cancer Registry was established in 1943 and is considered close to complete.<sup>15</sup> The birthplace of testicular cancer cases who were alive on April 2, 1968, was retrieved from the Danish Civil Registration System, whereas the birthplace of cases who had died before April 2, 1968 was obtained from their death certificates.<sup>16</sup> Population data were obtained from Statistic Denmark. Data concerning number of liveborn boys and number of boys who died under the age of one were available on a county level, whereas data concerning immigration, emigration, and death rates according to birth year were available on a country level.

During the study period, Denmark was administratively organized in the Capital consisting of three municipalities: Gentofte, Frederiksberg, and Copenhagen; and 24 counties: Hjoerring, Thisted, Aalborg, Viborg, Randers, Ringkoebing, Ribe, Aarhus, Skanderborg, Vejle, Toender, Haderslev, Aabenraa,