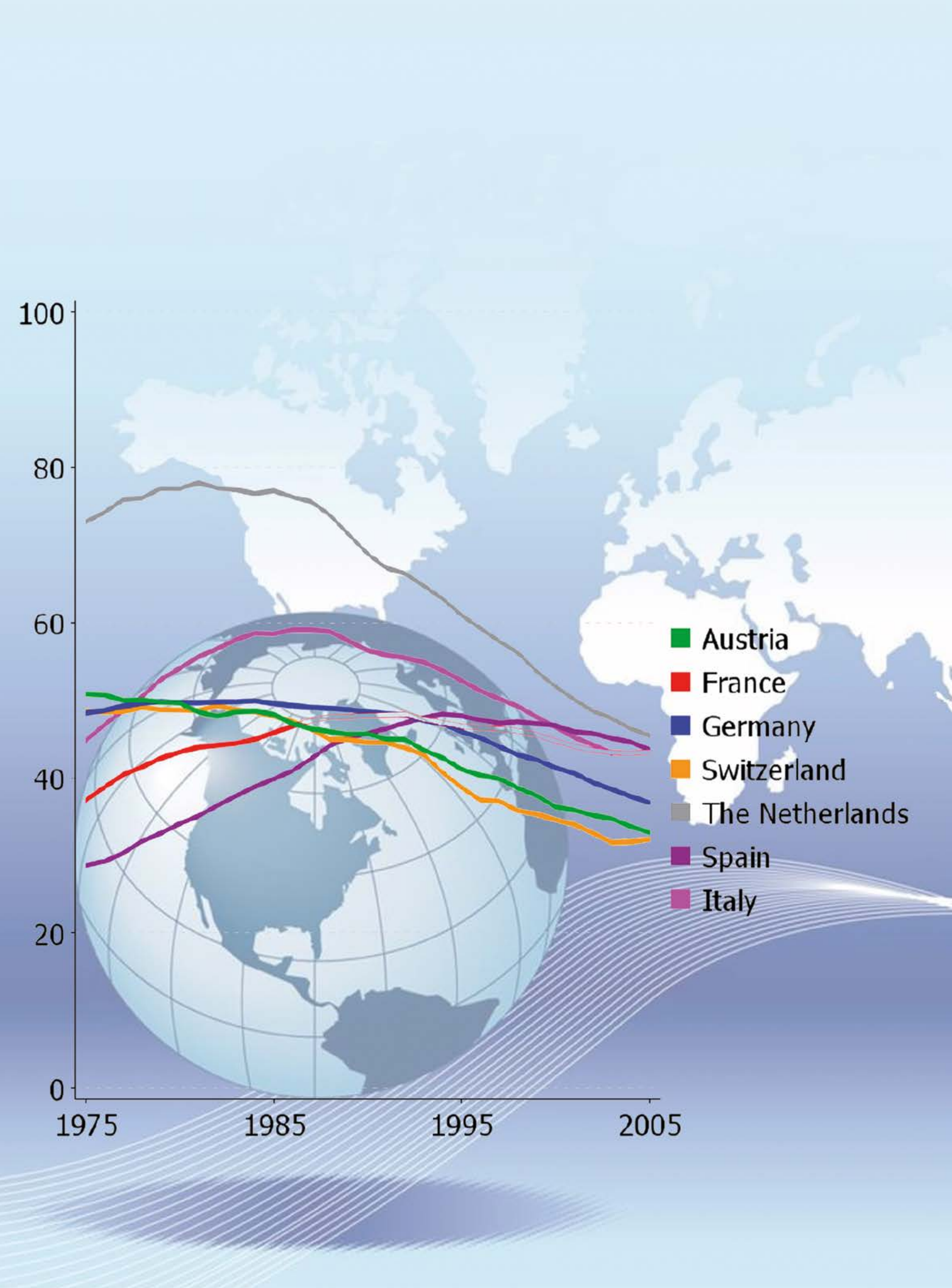
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The Section of Cancer Surveillance (CSU) compiles, analyses, interprets, and disseminates global cancer indicators that document the changing scale, profile, and impact of the disease worldwide. Three core areas of interrelated activity aim to support national as well as global cancer planning.

Cancer registry support and development

Close cooperation with population-based cancer registries (PBCRs) worldwide is an essential aspect of the Section's work, and CSU serves as the secretariat for the International Association of Cancer Registries (IACR), working closely with the umbrella organization and individual registries in collaborative studies, including *Cancer Incidence in Five Continents* (CI5). With cancer incidence set to rise to 20 million by 2025, and increasing by 70% in low- and middle-income countries (LMICs), cancer planning is critical but is currently impeded by the fact that only one third of countries (mostly high-income countries) are able to report high-quality cancer incidence data. The clear need for investment in PBCRs in LMICs led to the launch of the Global Initiative for Cancer Registry Development (GICR, http://gicr.iarc.fr). The goal is to inform cancer control through defined improvements in the coverage, quality, and usage of PBCRs worldwide. Operating to integrate activities at the global, regional, and national levels, partners share

Table 1. GICR IARC Regional Hubs

IARC Regional Hub (year established)	Area of coverage	Principal investigator	Main collaborators
Mumbai (2012)	South, East, and South-East Asia	Dr Rajesh Dikshit, Tata Memorial Hospital, India	Tata Memorial Hospital, Mumbai, India
African Cancer Registry Network (2012)	Sub-Saharan Africa	Dr Max Parkin, University of Oxford, United Kingdom	International Network for Cancer Treatment and Research
Izmir (2013)	North Africa, Central and West Asia	Dr Sultan Eser, Izmir Cancer Registry, Turkey	Cancer Control Department, Ministry of Health, Turkey
			Center for Global Health, National Cancer Institute, USA
Argentina (2014)	Latin America	Dr Graciela Abriata, National Cancer Institute, Argentina	National Cancer Institute, Buenos Aires, Argentina
			Brazil National Cancer Institute, Rio de Janeiro, Brazil
			Colombia National Cancer Institute, Bogotá, Colombia
			Uruguay Cancer Registry, Honorary Commission for the Fight Against Cancer, Montevideo, Uruguay
Caribbean (2015)	Caribbean	To be determined	Caribbean Public Health Agency, Port of Spain, Trinidad and Tobago
			Center for Global Health, Centers for Disease Control and Prevention, USA
			Center for Global Health, National Cancer Institute, USA
Pacific Islands (2015)	Oceania	To be determined	Cancer Institute New South Wales, Australia
			Cancer Council Victoria, Australia
			Cancer Council Queensland, Australia
			South Australian Health and Medical Research Institute, Australia

knowledge and adopt proven methods effectively across settings. Six IARC Regional Hubs have been established to deliver localized programmes of training, consultancy support, research, and advocacy (Table 1). Collectively, the IARC Regional Hubs target more than 6 billion people (85% of the world's population) in more than 150 underserved countries in Africa, the Americas, Asia, and Oceania. IARC Technical Publication No. 43, which is available in English, French, and Spanish, serves as a reference for health planners seeking to plan and develop PBCRs in LMICs.

During 2014–2015, several key activities of the GICR were achieved. Globally, the commitment of international partners to work together was secured, resulting in a unified solution to address disparities in cancer registration. The resulting GICR strategic plan was endorsed by the World Health Organization (WHO) as an official tool to support Member States in addressing cancer-related targets and indicators within the Global Monitoring Framework for the Prevention and Control of Noncommunicable Diseases (NCDs). Building on this, a group of initial focus countries have been identified to develop a mutual programme of activities among GICR global partners to increase the effectiveness of capacity-building in cancer registration. Highlights of the regional and national activities are listed in Table 2; key GICR collaborative partners are listed below.

Global cancer indicators: development and dissemination

CSU's two-tiered approach to global estimation involves validating estimates against recorded data of high quality where available and, where not, supporting in-country investments in data collection through the GICR, where feasible. The reporting of cancer statistics is generated through flagship projects, including CI5 and GLOBOCAN. After the computation of national estimates in 184 countries for 2012 and the launch of the GLOBOCAN 2012 website at the end of 2013, the 2014–2015 biennium has been devoted to documenting the source disparities, methods, and results (Ferlay et al., 2015a) and extending the use of GLOBOCAN to high-profile international collaborations. These include chapters in *World Cancer Report 2014*, the second edition of *The Cancer Atlas* (Jemal et al., 2014), and the cancer volume of the third edition of *Disease Control Priorities* (DCP3) (Bray and Soerjomataram, 2015), alongside peer-reviewed articles, including the Lancet Oncology Commission on Global Radiotherapy (Atun et al., 2015) and a JNCI Commentary on the importance of integrating primary prevention into cancer control strategies worldwide (Bray et al., 2015b).

Validation exercises include a comparative study of estimates derived from the nine methods used in GLOBOCAN versus high-quality recorded incidence data in Norway. The results broadly emphasize the high performance of trends-based estimation approaches and the need for population-based data to accurately estimate incidence. The development of national estimates that capture the uncertainty in source information is also a priority for the next iteration of GLOBOCAN, and collaborative work with the University of Washington (USA) is ongoing; a study examining the derivation of credible intervals using Bayesian models in estimating national breast cancer in Europe is under way.

GLOBOCAN estimation relies heavily on the collaboration of PBCRs worldwide

Table 2. GICR activities by region, 2014–2015

Activity	Total number	Region [number][a]			
		Africa	Asia	Caribbean	Americas
Site visits[b]	36	Algeria, Angola, Egypt, The Gambia, Madagascar, Malawi, Mali, Morocco, Namibia, Réunion, Senegal, Uganda, Zimbabwe [13]	Cambodia, India, Indonesia, Islamic Republic of Iran, Kyrgyzstan, Lao People's Democratic Republic, Philippines, Turkey, West Bank and Gaza Strip [9]	Aruba, Barbados, Grenada, Trinidad and Tobago [4]	Argentina, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru [10]
Courses	28	Côte d'Ivoire (Abidjan, August 2014); Egypt (Cairo, September 2014); Ethiopia (Addis Ababa, August 2015); Guinea (Conakry, August 2014); Kenya (Eldoret, March 2015); Kenya (Nairobi, August 2015); Mozambique (Beira, July 2014); Mozambique (Maputo, July 2014); Namibia (Windhoek, June 2014); Namibia (Windhoek, February 2015); Sudan (Khartoum, November 2014); Uganda (Kampala, June 2014) [12]	Cambodia (Phnom Penh, February 2014); China (Shanghai, September 2014); India (Chennai, March 2014); India (Chennai, October 2014); India (Mumbai, July 2014); Kazakhstan (Astana, September 2014); Myanmar (Yangon, September 2014); Russian Federation (Saint Petersburg, September 2015); Thailand (Bangkok, June 2015); Turkey (Ankara, October 2014); West Bank and Gaza Strip (Gaza City, July 2015); West Bank and Gaza Strip (Ramallah, July 2015) [12]	—	Canada (Ottawa, June 2014); Chile (Santiago, July 2014); El Salvador (San Salvador, October 2014); Panama (Panama City, November 2015) [4]
Signed agreements[c]	17	Congo, Côte d'Ivoire, Kenya, Mauritius, Mozambique, Senegal, South Africa, Uganda, Zimbabwe [9]	India, Islamic Republic of Iran, Turkey [3]	—	Argentina, Colombia, Guatemala, Mexico, Uruguay [5]

[a] Classified into continents according to IARC Regional Hub involvement; activities in Oceania will commence in 2016.

[b] Only initial visits to countries are listed.

[c] Includes agreements signed by the African Cancer Registry Network to provide the IARC Regional Hub for Sub-Saharan Africa.

and the high-quality registry data compiled in successive CI5 volumes. Volume X, released in late 2014, comprises cancer incidence data from 290 registries in 68 countries for 2003–2007. The increase in the number of high-quality PBCRs included in Volume X is offset by challenges in ensuring that data from more registries in LMICs are accepted in subsequent volumes. A recent paper documented the status of PBCRs worldwide (linking the registry capacity-building approaches of the GICR) and the techniques used in CI5 to evaluate quality (Bray et al., 2015a). The paper also highlighted the variability in cancer risk: a ratio of 3 to 45 was observed in the lowest versus highest rates for specific cancers worldwide (Figure 1). The call for data for the next volume (Volume XI) has been launched.

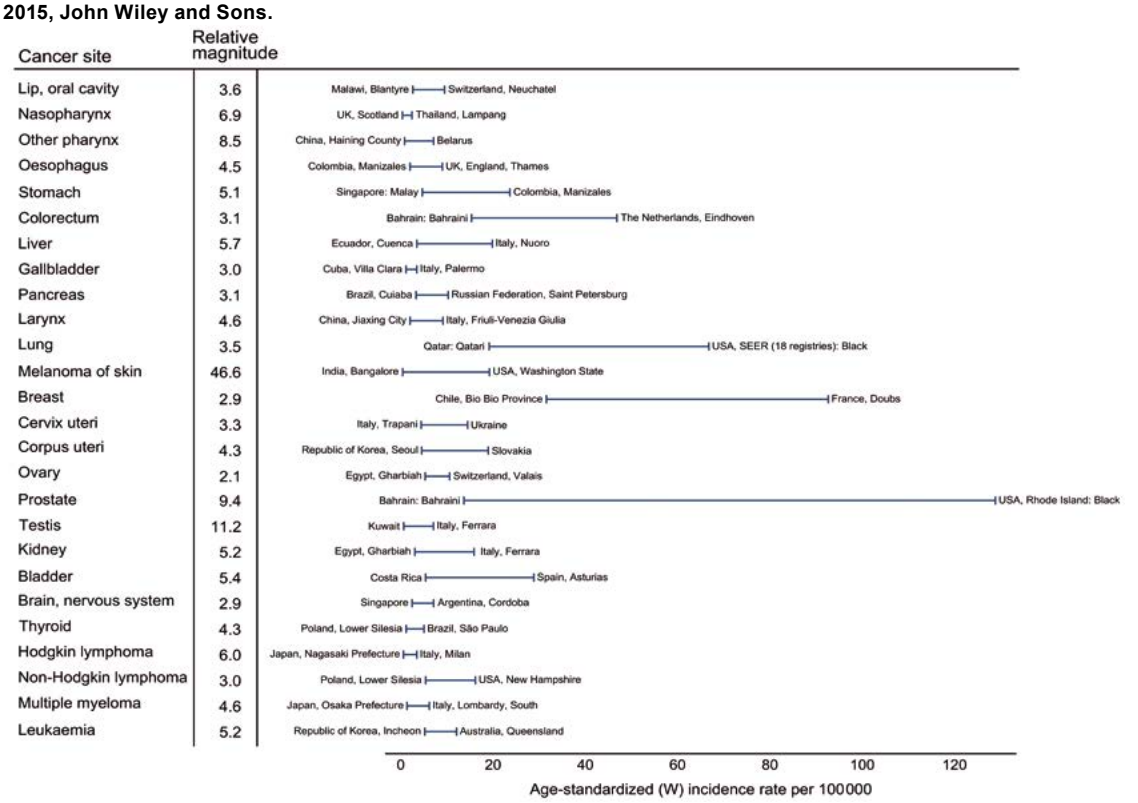
Childhood cancer surveillance is a major component of CSU's activities, and preparation of the third volume of *International Incidence of Childhood Cancer* (IICC3, http://iicc.iarc.fr/) is nearing completion. Data on cancer incidence in children and adolescents (ages 0–19 years) are being compiled in collaboration with more than 350 cancer registries. A European study undertaken within the EUROCOURSE project has estimated population coverage of children in the European Union by PBCRs at 80%; the growing formation of paediatric cancer registries was noted, as well as a merging of existing registries (Steliarova-Foucher et al., 2015a).

In supporting the development of cancer survival statistics in LMICs for benchmarking purposes, CSU is developing a third volume of the benchmark series *Cancer Survival in Africa, Asia, the Caribbean and Central America* (SURVCAN-3). Linked to local capacity-building, Module 1 of the IARC Summer School in 2015 focused on the training of registry staff in LMICs wishing to develop survival statistics at their registry (Figure 2). Finally, the Global Cancer Observatory (GCO) is under development by CSU following the recruitment of a web programmer in 2015. The GCO will serve as an interactive, user-friendly, and data-driven online interface to examine and interpret global and regional cancer statistics based on the key databases held at CSU.

Descriptive epidemiology of cancer: core activities and innovation

A diverse set of research collaborations aim to interpret the changing magnitude and the transitional nature of cancer profiles. As well as the continued provision of global and regional cancer statistics with collaborators worldwide based on the GLOBOCAN estimates (Parkin et al., 2014; Torre et al., 2015), data from successive CI5 volumes continue to provide critical insights into changing trends and profiles of specific cancers, their determinants, and priorities for cancer control. Ad hoc collaborative studies have been published that describe the regional and global trends in, for example, female breast cancer (DeSantis et al., 2015),

Figure 1. Absolute and relative global variations in age-standardized incidence rates (world) of registry populations included in CI5 Volume X. The variability in the age-standardized rates for 27 cancer sites is according to the 10th and 90th percentiles for males, other than for female breast and three female-specific cancers (cervix uteri, corpus uteri, and ovary). Reprinted with permission from Bray et al. (2015a). Copyright © 2015, John Wiley and Sons.



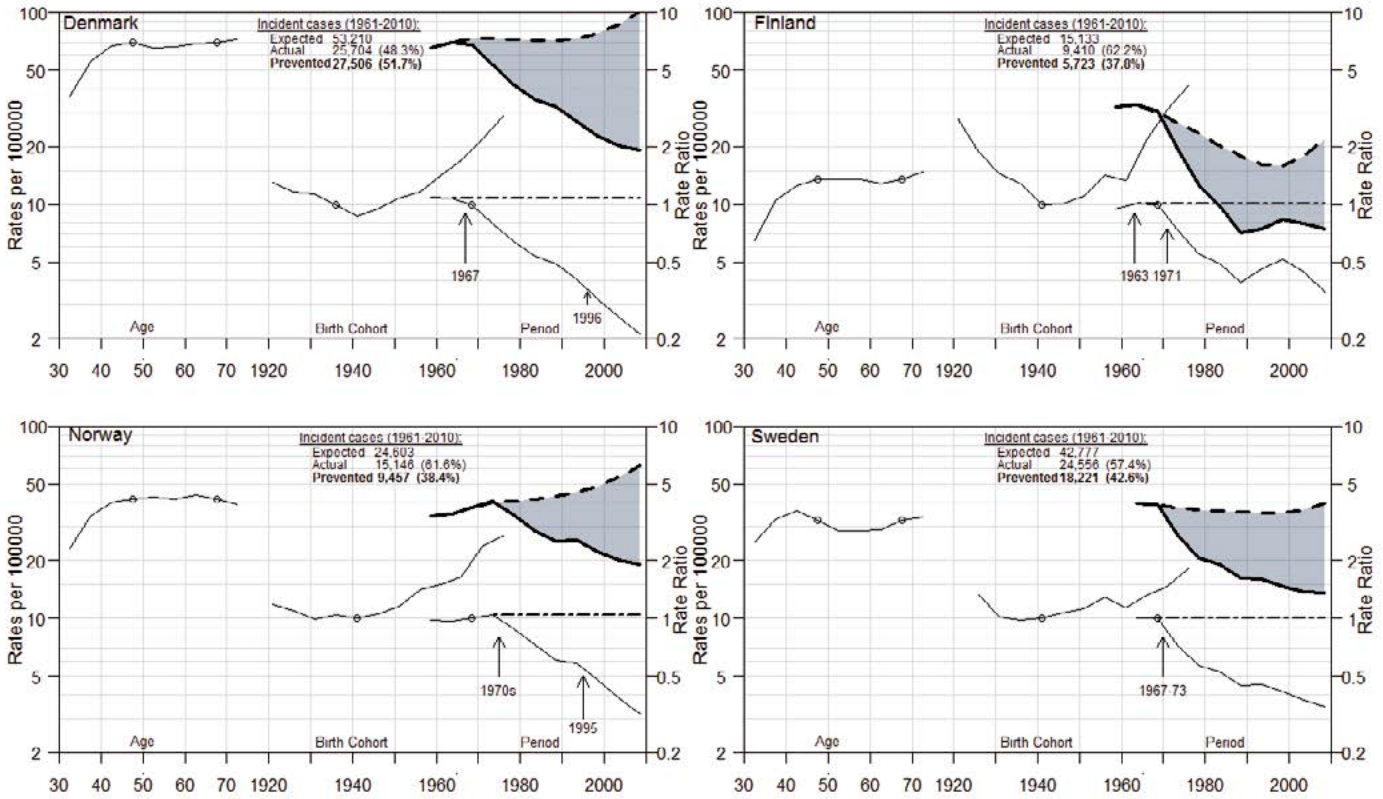
testicular cancer (Le Cornet et al., 2014; Trabert et al., 2015; Znaor et al., 2014, 2015a), bladder cancer (Chavan et al., 2014), renal cell carcinoma (Znaor et al., 2015b, 2015c), and bone cancer (Valery et al., 2015).

More specific studies in collaboration with the Infections and Cancer Epidemiology Group (ICE) have looked at international trends in thyroid cancer incidence and mortality in light of enhanced surveillance of the thyroid gland (Vaccarella et al., 2015), as well as the impact of screening on the burden of cervical cancer in the Nordic countries (Vaccarella et al., 2014). In the latter study, models predicted that up to 49% of the expected cervical cancer cases may have been prevented by the introduction of screening in the late 1960s and early 1970s (Figure 3). In a study describing the major decrease in incidence rates of upper urinary tract cancer in Australia in 1983–2007, Antoni et al. hypothesized that the ban on phenacetin, an analgesic that was marketed widely for pain relief until the late 1970s, explained the observed decline (Antoni et al., 2014).

Figure 2. IARC Summer School 2015, Module 1: Cancer Survival Methods for Cancer Registries. © IARC/Roland Dray.

Approaches to global cancer surveillance research include the assessment of cancer in Indigenous peoples (Moore et al., 2014a, 2014b), who have disproportionally worse health and lower life expectancy than their non-Indigenous counterparts in high-income countries. As part of an IARC-Australia Fellowship, a recent study compared, for the first time, the cancer burden among Indigenous populations in Australia, New Zealand, Canada, and the USA, based on incidence data derived from PBCRs (Moore et al., 2015). Of note were the high rates of lung cancer among Indigenous men in all Australian regions, and in Alberta, Canada, and in the USA among Alaska Natives. Among women, lung cancer rates were considerably higher in Māori women in New Zealand and in

Figure 3. Effect of age, period, and cohort on observed and projected age-standardized rates of incident cervical cancer in the Nordic countries. Reprinted with permission from Vaccarella et al. (2014).

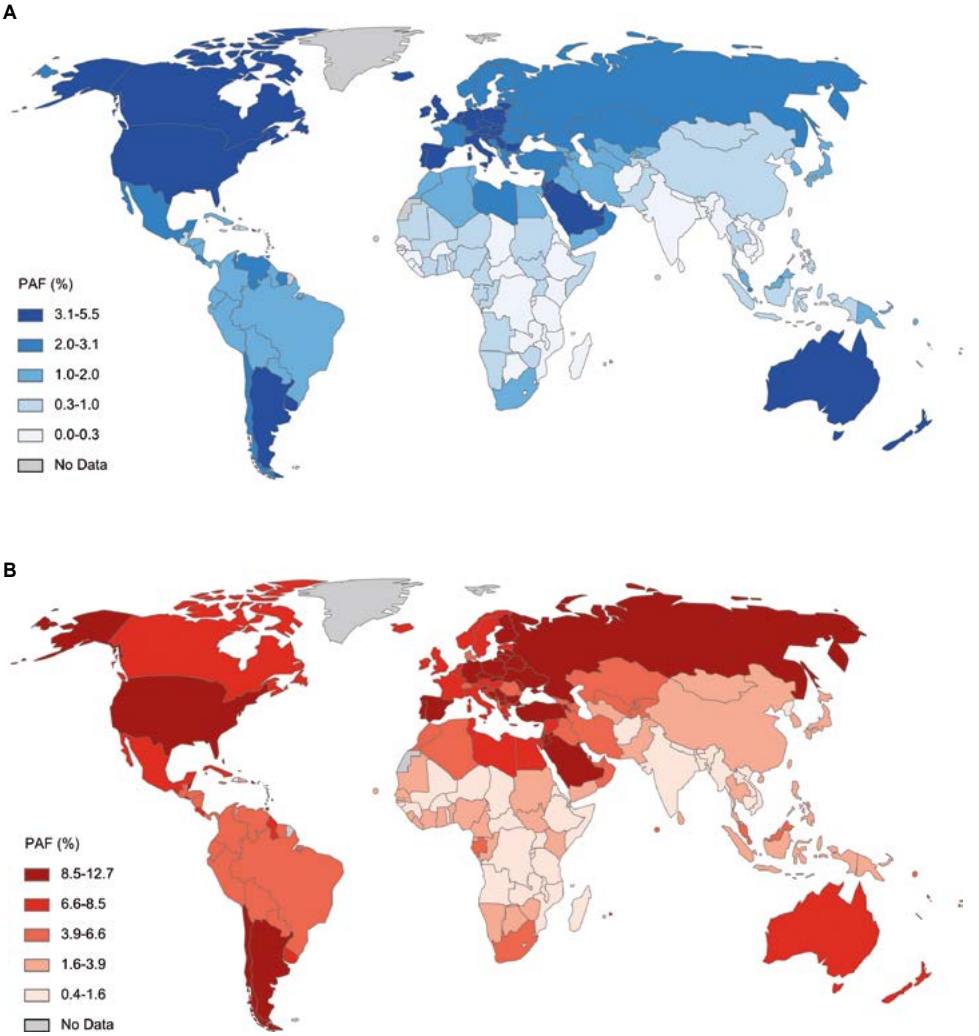


Alaska Natives, whereas cervical cancer incidence was higher among Indigenous women in most areas.

Studies also aim to increasingly capture the broader context of NCDs, as well as the continuum of cancer progression from a healthy state to end of life. Recent methodological research areas include the systematic development of population attributable fractions (PAFs) for various major risk determinants of cancer. An estimated half a million new cancer cases (or 3.6% of all new cancer cases) could be attributed to excess body weight (Figure 4) (Arnold et al., 2015a); further work will assess the time-specific risk of cancer after cumulative exposure to excess body weight over the life course. Worldwide PAF estimates for tobacco, alcohol, infection, and other major risk factors are under development. CSU is also embarking on major PAF projects in France (partnering with Institut national du Cancer [INCa]) and the Eastern Mediterranean region (with the WHO Regional Office for the Eastern Mediterranean) that will estimate the proportion of cancers attributable to key lifestyle and environmental determinants. These projects rely heavily on collaboration and multidisciplinary groups of experts.

Several studies link the changing demographic, epidemiological, and cancer transitions to the evolving NCD agenda. For example, an average loss of life expectancy of 2.4 years in men and 1 year in women, associated with tobacco smoking, has recently been reported. With rates of cardiovascular disease declining due to the success of preventing and treating the disease, cancer contributed to a larger portion of the total mortality in 1980–2010. Hanly et al. have examined the societal loss related to premature mortality from cancer among the workforce of Europe (Hanly et al., 2015). The average cost of productivity lost due to premature mortality was estimated at 0.58% of the 2008 European gross domestic product, highest in central and eastern Europe (0.81%) and lowest in northern Europe (0.51%). The analysis highlighted the potential advantages of implementing prevention strategies for stomach, pancreatic, and cervical cancer and melanoma of the skin, and of improving access to treatment for Hodgkin lymphoma and testicular cancer.

Figure 4. Population attributable fraction (PAF) of new cancer cases in 2012 due to excess body mass index in (A) men and (B) women, by country. Reprinted from Arnold et al. (2015a). Copyright 2015, with permission from Elsevier.



CSU is grateful to the following for their collaboration:

Graciela Abriata, Florencia Moreno, Argentina; Jeff Dunn, Suzanne Moore, David Roder, Australia; Nelly Enwerem-Bronson, Luca Li-Bassi, Austria; Marc Arbyn, Belgium; Walter Zoss, Brazil; Mary Gospodarowicz, Ophira Ginsburg, Prabhat Jha, Brian O'Sullivan, Juergen Rehm, Canada; Wanqing Chen, China; Esther de Vries, Colombia; Ibithal Fadhil, Egypt; Jacqueline Clavel, Brigitte Lacour, Gwenn Menvielle, France; Peter Kaatsch, Germany; Rajesh Dikshit, Rajamaram Swaminathan, India; Kazem Zendehdel, Islamic Republic of Iran; Roberto Zanetti, Italy; Sabine Siesling, The Netherlands; Bjorn Moller, Elisabete Weiderpass, Norway; Hee Young Shin, Republic of Korea; Paul Dickman, Lars Hjorth, Sweden; Robert Jakob, Colin Mathers, Gretchen Stevens, Julie Torode, Andreas Ullrich, Switzerland; Malcolm Moore, Suleeporn Sangrajrang, Thailand; Sultan Eser, Murat Gultekin, Turkey; Anton Ryzhov, Ukraine; David Conway, Majid Ezzati, Paul Lambert, Max Parkin, Kathy Pritchard-Jones, Andrew Renehan, Brian Rous, Mark Rutherford, Linda Sharp, Charles Stiller, Paolo Vineis, United Kingdom; Enrique Barrios, Uruguay; Hoda Anton-Culver, Brenda Edwards, Susan Devesa, Lindsay Frazier, Ahmedin Jemal, Katherine McGlynn, Angela Mariotto, Mona Saraiya, Silvana Luciani, Lisa Stevens, Jon Wakefield, Kevin Ward, USA.

Financial support from the following bodies is gratefully acknowledged:

Institut national du Cancer (France) – convention 2013-222, 2015-002
Medical Research Council, United Kingdom
Seventh Framework Programme (FP7/2007–2013) of the European Commission, grant agreement LSSH–CT–2008–21 9453 (EUROCOURSE)
Seventh Framework Programme (FP7/2007–2013) of the European Commission, grant agreement HEALTH.2010.2.4.1-7257505 (PanCareSurFup)
Seventh Framework Programme (FP7/2007–2013) of the European Commission, grant agreement HEALTH.2010.2.4.1-3 261474 (ENCCA)
Marie Curie Action Intra-European Fellowship, contract number 302050
World Cancer Research Fund, grant agreement SG 2012/619
GAVI Alliance
National Cancer Institute, National Institutes of Health, USA
American Cancer Society, USA
Centers for Disease Control and Prevention, USA
Union for International Cancer Control (UICC)
Dutch Cancer Society
WHO Regional Office for the Eastern Mediterranean, for support to the GICR