## GLOBAL STATUS OF EPIDEMIOLOGY

# Population health and status of epidemiology: WHO European Region I

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**Background** This article of the International Epidemiological Association commissioned paper series stocktakes the population health and status of epidemiology in 21 of the 53 countries of the WHO European Region. By United Nations geographical classification, these countries belong to Eastern Europe, Western Asia and South-Central Asia.

**Methods** Published data were used to describe population health indicators and risk factors. Epidemiological training and research was assessed based on author knowledge, information searches and E-mail survey of experts. Bibliometric analyses determined epidemiological publication outputs.

**Results** Between-country differences in life expectancy, amount and profile of disease burden and prevalence of risk factors are marked. Epidemiological training is affected by ongoing structural reforms of educational systems. Training is advanced in Israel and several Eastern European countries. Epidemiological research is mainly university-based in most countries, but predominantly conducted by governmental research institutes in several countries of the former Soviet Union. Funding is generally external and limited, partially due to competition from and prioritization of biomedical research. Multiple relevant professional societies exist, especially in Poland, the Czech Republic and Hungary. Few of the region's 39 epidemiological academic journals have international currency. The number of epidemiological publications per population is highest for Israel and lowest for South-Central Asian countries.

**Conclusions** Epidemiological capacity will continue to be heterogeneous across the region and depend more on countries' individual historical, social, political and economic conditions and contexts than their epidemiologists' successive efforts. National and international

research funding, and within- and between-country collaborations should be enhanced, especially for South-Central Asian countries.

**Keywords**    European region, epidemiology, disease burden, epidemiological research, epidemiological training

## Introduction

The current article belongs to an eight-paper series commissioned by the International Epidemiological Association (IEA) to stocktake population health status and epidemiological capacity in the six World Health Organization (WHO) regions. For the purpose of this series, the 53 countries of the WHO European Region were sub-divided somewhat arbitrarily into two sub-regions. This article covers the 21 countries that we refer to as 'the EURO I region'. Another forthcoming article will characterize the remaining countries of the WHO European Region.

Our work on the EURO I region will enable the IEA, like other stakeholders, to identify the need and set strategic priorities for planning and implementing epidemiological capacity-building efforts in the EURO I region and globally.

Taking into consideration the United Nations geographical classification,[1] the EURO I region encompasses all 10 countries of Eastern Europe (Belarus, Bulgaria, the Czech Republic, Hungary, the Republic of Moldova, Poland, Romania, the Russian Federation, Slovakia, the Ukraine); six of Western Asia (Armenia, Azerbaijan, Cyprus, Georgia, Israel, Turkey); and five of South-Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan). According to World Bank classification,[2] the region has two low-income economies ($\leqslant$ USD 1005 of gross national income per capita in 2010; Kyrgyzstan, Tajikistan); six lower middle-income economies (USD 1006–3975; Armenia, Georgia, the Republic of Moldova, Turkmenistan, Ukraine, Uzbekistan); seven upper middle-income economies (USD 3976–12 275; Azerbaijan, Belarus, Bulgaria, Kazakhstan, Romania, the Russian Federation, Turkey); and six high-income economies ($\geqslant$ USD 12 276; Cyprus, the Czech Republic, Hungary, Israel, Poland, Slovakia).

The EURO I countries vary substantially in territorial and population size.[3,4] The Russian Federation with its 17 million km$^2$ territory and 143 million population is the world's largest country and the region's most populous country. Cyprus has the region's smallest territory (9.3 thousand km$^2$) and smallest population (1.1 million). The total population of the EURO I region is 452 million, constituting 6.6% of the world population in 2009. In 2005–2010, the rate of natural population increase (per 1 000 population) is the highest in South-Central Asia (14.8) and the lowest in Eastern Europe (-2.8). For comparison, this rate in the world is 11.6. In 2010, total health expenditure (as a percentage of gross domestic product) ranged from 2.5 (Turkmenistan) and 4.3 (Kazakhstan) to 10.1 (Georgia) and 11.7 (the Republic of Moldova).

The EURO I countries are undergoing constant reform of educational,[5,6] research, health care and public health service[7–12] frameworks and systems, with mixed success. These reforms generally started in the early 1990s with the disestablishment of communist regimes and countries. Even during the writing of this paper in 2012, major restructuring took place in Turkey, where the Public Health Institution was established.

In this paper, we describe the population health and status of epidemiological training and research systems, funding and research outputs in the EURO I region.

## Methods

For presenting key population health indicators, determinants of health, and other relevant country-specific information, published papers were identified from academic databases, including PubMed (http://www.ncbi.nlm.nih.gov/pubmed) and Thomson Reuters Web of Knowledge (http://wokinfo.com). Additionally, data on global health and disease risk factors were extracted from the WHO[13–20] and other organizations,[21–24] as well as development and demographic indicators from the United Nations[1,4,25] and World Bank.[2,3] On several occasions, published country-specific data were used for calculating medians (e.g. of life expectancy and mortality rate) or other measures for specific countries. Information on epidemiological training, research and funding, professional societies and academic journals is based on authors' knowledge, internet searches, published research and e-mail survey of epidemiologists and other experts from relevant countries. The quality and completeness of the information gathered by us and received from others may have suffered from the poor quality of disease registration, inaccuracies in internet sources and relatively high non-response to enquiries. Detailed explanations of the weaknesses in some of the data for the EURO I region can be found in appropriate reports referred to above and below.

For estimating publication activity, we followed the approach and search strategies used in other articles of the series[26–28] to ensure methodological consistency and comparability of findings. The first analysis determined, for each country of the region, the number of epidemiological publications reporting about the country. The number of MEDLINE-indexed

publications with 'epidemiology' as a Medical Subject Heading (MeSH) or 'epidemiol*' in the title or abstract, and with the name of the country included as a MeSH or appearing either as a keyword or in the title or abstract of the paper was determined. We then calculated the publication rate—the ratio of the number of epidemiological papers about the country published in 2002–2011 to the population size of the country in 2007, expressed per one million of population.

# Findings

## Life expectancy, morbidity and mortality

For 2009, the region's median life expectancy at birth is 70 years, just below the global median of 72 years. The lowest life expectancy in the region is observed for Turkmenistan (63 years), followed by Kazakhstan (64 years) and Kyrgyzstan (66 years). The countries with the highest life expectancy are Israel (82 years), Cyprus (81 years), the Czech Republic (77 years) and Poland (76 years).[20] Life expectancy is higher for high-income than for low- and middle-income countries (Figure 1).

Numerous political, economic and social upheavals that took place in the majority of the EURO I countries at the end of the 1980s and beginning of the 1990s led to decreases in life expectancy of 1–7 years over differing time periods in 13 countries. Particularly sharp drops in life expectancy were observed for the Russian Federation, Kazakhstan, Belarus, Kyrgyzstan and the Ukraine. The steepest decline (from 65 years in 1988 to 58 years in 1994) was recorded for the Russian Federation, where now (20 years later) life expectancy has not yet reached its previous level.[3] The decline, particularly in males, has been characterized as one of 'the most significant and unexpected developments in world health' during the second half of the past century.[29]

Female exceeds male life expectancy markedly in Belarus, the Russian Federation and the Ukraine (all by 12 years); the smallest gender differences are observed for Israel and Tajikistan (both 3 years). In the Russian Federation, where time trends in life expectancy have been monitored closely for a long time[30–33] during the first decade of the 21st century, the largest gender gap of 13.5 years was observed in 2005.[29] Gender differences in life expectancy in Eastern Europe are the widest ever recorded in the world during a time of peace.[34]

The total burden of disease, as measured in age-standardized disability-adjusted life-years (DALY),[15] varies widely between countries (Figure 1). For example, Kazakhstan and Turkmenistan carry a total disease burden that is 2.4–2.9 times higher than that of Israel and the Czech Republic. Disaggregating the total disease burden by the three main disease groupings (communicable diseases and nutritional, maternal and perinatal conditions; non-communicable diseases;

injuries)[14] demonstrates considerable between-country differences in the contribution of these disease groups to the total burden of disease. The proportion of total disease burden attributable to communicable diseases and nutritional, maternal and perinatal conditions is high for Tajikistan (43%) and Turkmenistan (32%), but low for the Czech Republic (5%) and Hungary (6%). Non-communicable diseases contribute 80–85% of the total disease burden in Poland, Bulgaria, Slovakia, the Czech Republic, Cyprus, Hungary and Israel, but only 52–59% in Tajikistan and Turkmenistan. The burden of injuries in the Russian Federation (25%) and Belarus (21%) is four to five times that of Azerbaijan, Georgia and Tajikistan (4–5%).

Although several communicable and non-communicable disease measures are established, they must be interpreted cautiously, because health statistics in several countries are incomplete and, if politically sensitive, may have been manipulated.[5,12,35–39] For example, the Turkmenistan government routinely hides population health information from its citizens and the international community.[40]

Tuberculosis, an important emerging disease in the region, has high estimated incidence and prevalence rates per 100 000 of population for 2010 within the region and globally for Tajikistan (206 and 382, respectively), the Republic of Moldova (182 and 277) and Kyrgyzstan (159 and 243). The region's smallest rates are observed for Cyprus (4.4 and 5.5). Between-country differences in multidrug-resistant tuberculosis among incident cases are also marked, with 26 per 100 000 of population in Belarus, compared with 0 in Slovakia.[19]

HIV infection rates per 100 000 of population for 2010 are high in the Russian Federation (44.1), the Ukraine (36.4), and the Republic of Moldova (19.7), but low in Turkmenistan, Slovakia, Romania and Turkey (0.0–0.7).[17]

A review of drug-related mortality rates for Bulgaria, Cyprus, the Czech Republic, Hungary, Poland, Romania, Slovakia and Turkey in 2009 found the highest rate for Cyprus (20.8 per million of 15–64 year olds) and the lowest for Romania (2.1).[22]

Complete cancer registries are maintained only for Belarus, Bulgaria, the Czech Republic, Israel and Slovakia, and for selected areas in Cyprus (five government-controlled districts), Poland (Cracow, Kielce, Warsaw), the Russian Federation (St Petersburg) and Turkey (Antalya, Izmir).[13] Therefore, robust cancer incidence statistics are available for approximately 12% of the region's population. However, for 1998–2002, age-standardized (UICC world standard population) cancer (without skin non-melanoma) incidence rates per 100 000 of population are highest for the Czech Republic (males: 332, females: 240) and lowest for the Turkish province of Antalya (males: 162, females: 110).

For 2008, age-standardized (WHO world standard population) mortality rates per 100 000 of population
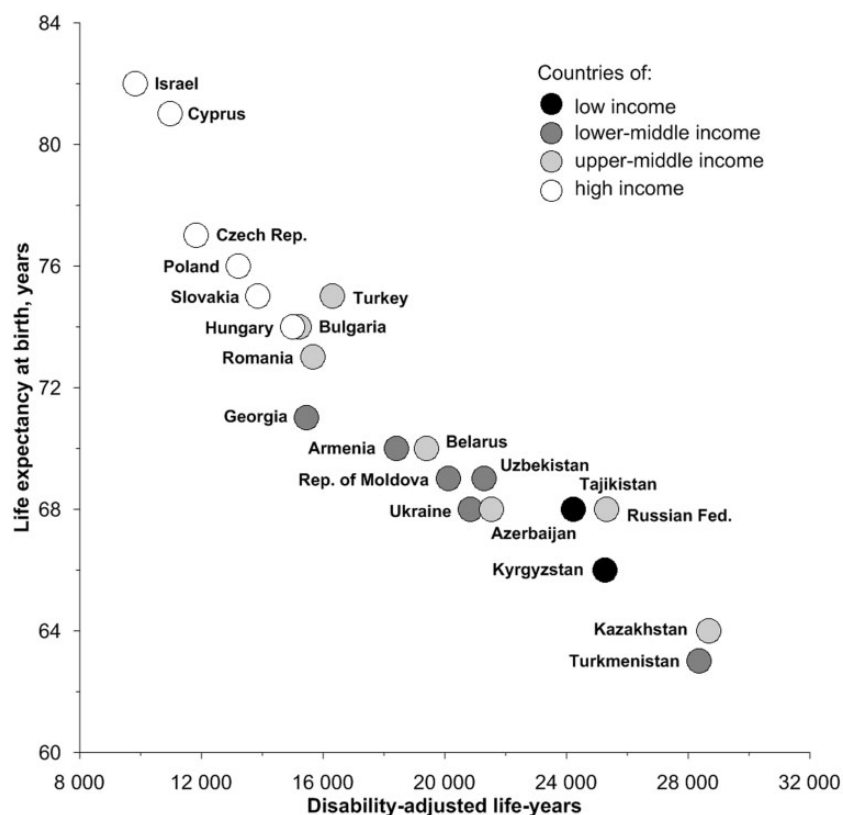
**Figure 1** Age-standardized disability-adjusted life-years[15] (2004) and life expectancy[20] at birth (2009) in 21 countries of the EURO I region. Countries are aggregated into four groups by 2010 gross national income per capita[2]
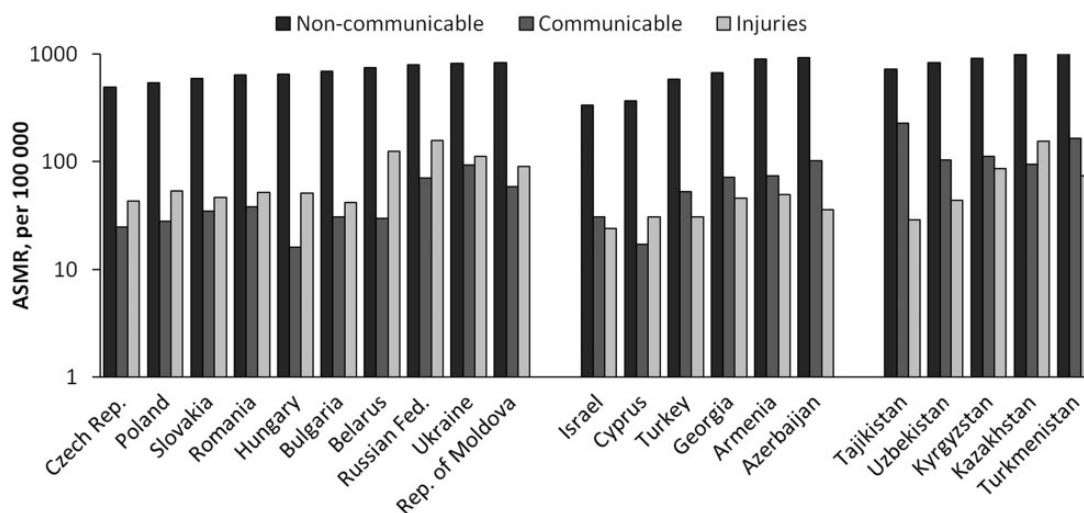


**Figure 2** Age-standardized mortality rates (ASMR; WHO world standard population)[20] of non-communicable diseases, communicable diseases and injuries in 21 countries of the EURO I region in 2008. Countries are aggregated into three groups (Eastern Europe, Western Asia, South-Central Asia) and ordered by increasing ASMR of non-communicable diseases

for communicable diseases range from 16 in Hungary to 229 in Tajikistan, and those for non-communicable diseases from 337 in Israel to 1016 in Turkmenistan[20] (Figure 2). Mortality from injuries is high in the Russian Federation, Kazakhstan, Belarus and the Ukraine, and low in Israel, Tajikistan, Cyprus and Turkey. Generally speaking, the South-Central Asian countries experience the highest mortality from communicable diseases and some also suffer high mortality from non-communicable diseases.

As a recent review of 171 countries in 2008 shows,[41] four South-Central Asian, four Eastern European and two Western Asian countries are amongst the top dozen countries with the highest (indirectly age-standardized) rates of ischaemic heart disease, the leading cause of death worldwide.

The region's median estimated under-five mortality rate for 2010 is 15.2 per 1000 live births. National rates range from 2.8 in Cyprus to 49.7 in Tajikistan,[42] with the highest rates observed for South-Central Asian countries, followed by Western Asian countries (except Cyprus and Israel). The region's highest rates are approximately four times lower than those of Western Sub-Saharan African countries, which suffer the world's highest under-five mortality.

Disease burden and mortality patterns suggest that non-communicable diseases prevail in all 20 countries. At the same time, the share of communicable diseases continues to be high in South-Central Asia, particularly Tajikistan and Turkmenistan.

Certainly, one of the most striking features of population health in the EURO I region is the unprecedentedly high mortality among working-age males that appeared in the countries of the communist bloc during the second half of the 20th century. This unfavourable mortality pattern, known as the 'state socialist mortality syndrome',[43] reflects an excess of deaths from circulatory system diseases and external causes related mainly to mass psychological stress and risky health behaviour (problematic diet, alcohol use, tobacco smoking).[44–46] Among the most hotly debated issues are the mechanisms that caused the abnormally high levels and sharp fluctuations of mortality during the era of political and economic reconstruction in the Russian Federation. Remarkably, alcohol use appears to have caused half of all deaths among working-age men.[47,48]

Socio-economic health inequalities in the EURO I countries have been noticed.[49–63] These inequalities, while varying regionally in magnitude, are wide in all countries of the region, especially so in Eastern European countries, and, for some of these countries, are widening. The established educational, ethnic, religious, occupational, residential, income and other kinds of inequalities cover a broad spectrum of health-related phenomena, including self-assessed health, disability, cervical cancer screening, amenable/avoidable mortality, total and cause-specific mortality and life expectancy at birth. For example, the relative risk of avoidable death of lower-educated people compared with higher-educated people is 5.34–5.35 in the Czech Republic and Poland, but much lower (2.26–2.78) in the Nordic countries.[57] In the Russian Federation, the gap in life expectancy between managers/professionals and skilled manual workers in males at age 21 is nearly 10 years.[60] In the same country, Northern Indigenous peoples' life expectancy is 13 years lower than the Russian average due to high infant and middle-age mortality.[64] Compared with the national average, the life expectancy of Roma is 14.4 years lower for females and 11.5 years lower for males in the Czech Republic; 8 years lower for males in Slovakia; and 5.7 years lower for males in Bulgaria, reflecting high infant mortality and risk factor prevalence (especially alcohol, tobacco and other drug use).[65,66] In Israel, Arab life expectancy for females is 3 years and for males 4 years below Jewish life expectancy.[67]

## Risk factors for diseases

The prevalence of 17 risk factors[16] in the EURO I region (and globally) is shown in Figure 3. The population of the region has greater access to improved sanitation and a relatively high prevalence of overweight (body mass index 25.0–29.9 kg/m$^2$) and obesity (body mass index $\geqslant$ 30.0 kg/m$^2$), compared with the world average. However, the EURO I population is much less exposed to urban outdoor air pollution and indoor smoke from solid fuels, and children are much less seldom affected by vitamin A deficiency.

The obesity epidemic is pronounced among males in countries such as the Czech Republic, Hungary, Cyprus and Slovakia, where 25–31% of the adult ($\geqslant$ 20 years) male population are obese. In contrast, only 8–12% of adult males are obese in Tajikistan and Belarus. The percentage of obese adult females is high in Turkey (36), Azerbaijan (32) and Armenia (30), but low in Tajikistan (12), Turkmenistan (15) and Romania (19). However, the region's highest female obesity prevalence, which is observed for Western Asian countries, is approximately twice lower than the global maximum observed for WHO Western Pacific Region countries. Female exceeds male obesity prevalence in all Western Asian and South-Central Asian countries, and almost half of the Eastern European countries. The female/male ratio of obesity prevalence is especially high in the Republic of Moldova (2.9), Armenia (2.1), Azerbaijan (2.0) and Kyrgyzstan (1.8).[20]

The prevalence of the important risk factors—alcohol use and tobacco smoking—in the EURO I region somewhat exceeds that in the world. Using statistics from (or around) the year 2008, adult per capita alcohol consumption is considerably higher in the Eastern European countries than in the other 10 countries of the region. The most severe consumption of alcohol takes place in the Republic of Moldova (the equivalent of 20.61 litres of pure alcohol) and the Czech Republic (15.26). Alcohol consumption is smallest in Tajikistan (0.34) and Turkey (1.34).[18] In terms of the prevalence of any alcohol drinking (during the past 30 days) in 15–16-year-old schoolchildren, the Czech Republic ranks first amongst 36 European countries, with 81% in boys and 77% in girls.[24] Although using inconsistent definitions and fragmentary data, cross-country comparative studies[18,21,65–70] show that the proportion of people who engage in binge (or episodic heavy) drinking is relatively high in Belarus, the Czech Republic, Georgia, Hungary, Kazakhstan, Poland, Romania, the Russian
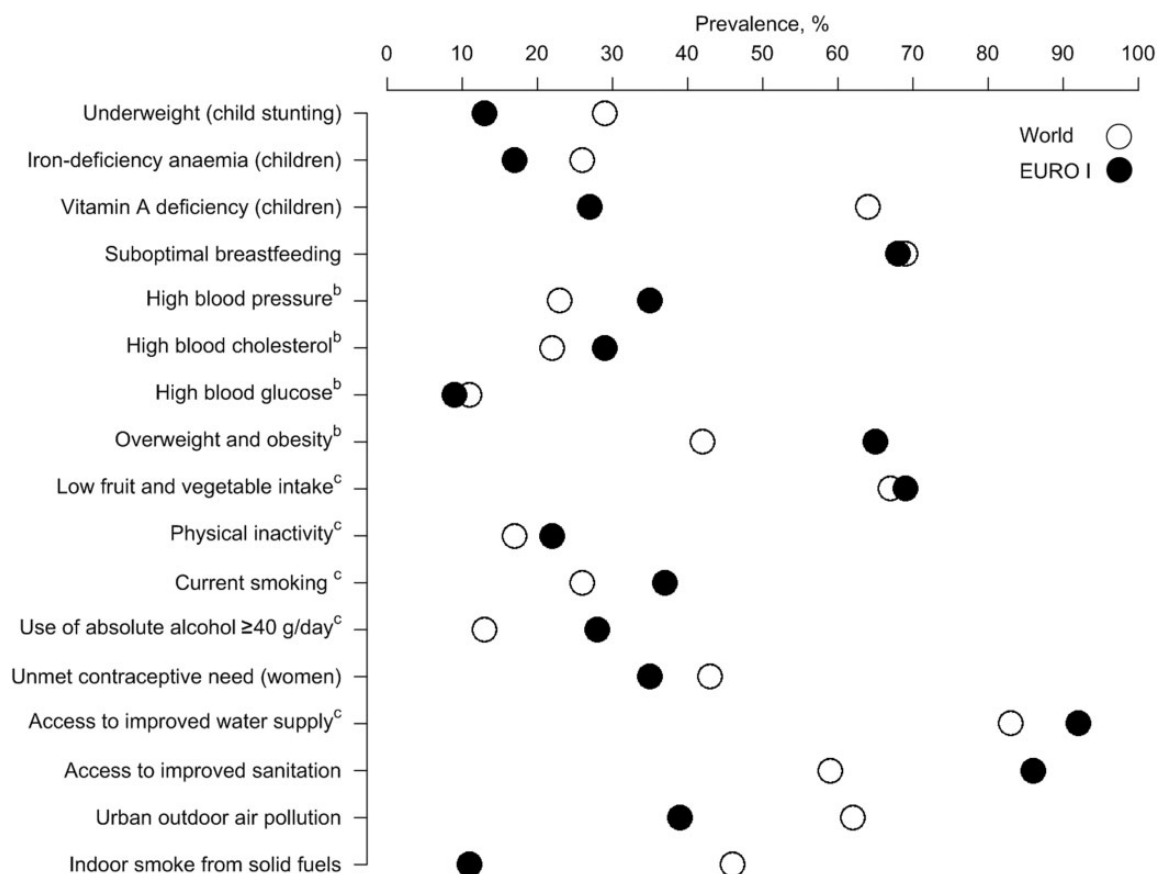
**Figure 3** Prevalence proportions of selected risk factors[16] in the EURO I region[a] and globally in 2004. [a]In this case, data cover 27 low- and middle-income countries of the WHO European region, of which 19 belong to the EURO I region. [b]Population aged $\geqslant 30$ years. [c]Population aged $\geqslant 15$ years

Federation and the Ukraine. Of the 150 countries studied, the Russian Federation and the Ukraine are the only countries scored to have the riskiest drinking patterns (score 5 on a scale of 1–5). Belarus, the Republic of Moldova and Kazakhstan, together with seven countries in Africa, Central America and Latin America, have very risky drinking patterns (score 4). Furthermore, Armenia, Bulgaria, Georgia and Turkey have somewhat risky drinking patterns (score 2).[18]

The age-adjusted (WHO world standard population) prevalence of current tobacco smoking for 2009 among adult ($\geqslant 15$ years) males is highest in the Russian Federation (59%), followed by Georgia (57%), Armenia (51%) and the Ukraine (50%). Among females, Hungary ranks first (33%), the Czech Republic second (31%) and Bulgaria third (27%). Smoking is less prevalent in South-Central Asian countries.[20]

Among the most widely discussed environmental risk factors is radioactive pollution, caused by the Chernobyl accident in 1986. This accident, the severest in the history of the nuclear industry, released large amounts of radioactive materials over vast areas of Europe, most heavily the Ukraine, Belarus and the Russian Federation, exposing around 6 million people to high levels of radiation.[23] Teasing apart the adverse health effects of this exposure to radiation from those of the huge socioeconomic changes accompanying the collapse of the Soviet system, is a very complicated scientific task. Unfortunately, as pointed out by Balonov,[71] often groundless conclusions about the consequences of Chernobyl for population health are drawn. More generally, occupational and environmental exposures (such as ambient air pollution) present much less serious public health problems in the EURO I region than alcohol and tobacco use.[46]

## Training in epidemiology

Several Europe-wide processes have changed epidemiological training in the EURO I region in recent times. Following the Bologna process directives and the goals of the European Higher Education Area (http://www.ehea.info), many EURO I countries have reformed or are currently reforming at different speeds their educational frameworks and systems to harmonize academic degree standards and credit systems. Presumably, the move to comparable bachelor's, master's and doctoral degrees and European Credit Transfer and Accumulation System (ECTS)

credits has harmonized epidemiological training across the EURO I (and indeed all European) countries. However, because of these ongoing reforms, epidemiological training in the EURO I countries currently commonly takes place within the transition from single to joint degree and old to new credit systems.[72–74] Furthermore, the establishment of the European Union (EU) Master of Science in Epidemiology (http://www.lshtm.ac.uk/study/cpd/eu_mse.html) and European Master of Science in Advanced Epidemiology in Clinical and Genetic Research programmes (http://madeineur.eu) has also benefited epidemiology in the EURO I countries.

Systematic undergraduate epidemiological training is lacking in the region. Standard postgraduate training models are Master of Public Health (MPH; 1–2 years of full-time study) and dedicated doctoral programmes in epidemiology or public health (3–5 years). Non-degree specialization courses for physicians and other health care professionals are another common training model. These postgraduate qualifications are generally offered by medial schools, schools of public health and/or doctoral schools. For example, 18 schools from the region are registered with the Association of Schools of Public Health in the European Region and six institutes with the International Association of National Public Health Institutes. The establishment of doctoral schools has proved to provide an excellent opportunity to initiate doctoral programmes in epidemiology.

However, postgraduate epidemiological and public health training in the region continues to differ greatly between and within countries (Supplementary Table 1, available as Supplementary data at *IJE* online). Because individual training programmes, qualifications, grading systems and even terms used to denote epidemiology vary, it is worth describing, for selected countries, standard educational pathways for epidemiologists. In Poland, physicians, dentists and other health care professionals can obtain specialist postgraduate diplomas in epidemiology and public health. Nurses and midwives can study to become 'nurse epidemiologists'. All medical and non-medical graduates can obtain MPH and Doctor of Health Sciences (DHSc) degrees. In Slovakia, the Slovak Medical University's epidemiology and public health 'attestation courses', although not leading to a full university degree, enable physicians to specialize in epidemiology. Although MPH programmes are primarily oriented towards health care management, they nevertheless strongly emphasize epidemiology, public health and hygiene. A second doctoral degree, the Doctor of Sciences (DSc), can be obtained for the highest scientific achievements. In Turkey, public health departments provide MPH and/or PhD programmes through institutes of health sciences to medical and non-medical graduates, and public health departments in medical schools offer public health specialization programmes, equivalents of PhD programmes, to physicians. In Israel, the Braun School of Public Health and

Community Medicine, a benchmarking training institution hosting the region's only WHO Collaborating Centre for Capacity Building in Public Health and supplying the entire region with epidemiologists,[75] offers the International MPH to medical and non-medical graduates. In Turkmenistan, doctoral training in all fields of study, including epidemiology, was abolished in the mid-1990s as a consequence of political and economic turmoil, but re-established in 2007.[76]

Postgraduate epidemiological training in the post-Soviet countries such as Belarus, the Russian Federation, Tajikistan and the Ukraine deserves particular attention. These countries have an inherited legacy of two levels of unique doctoral degrees awarded for research (and not obtainable through training). These degrees are the Candidate of Science (CSc, 'Kandidat Nauk'), which as the first doctorate is broadly equivalent to a PhD, and the Doctor of Sciences (DSc, 'Doktor Nauk'), which as the second and highest-level doctorate is somewhat comparable to the German post-doctoral lectureship qualification ('Habilitation'). Earning a CSc degree, which usually takes 3 years minimum, generally requires a master's degree (or equivalent higher professional education such as a medical degree); passing three exams; independently carrying out and publishing the results of a research study; and writing and publicly defending a dissertation at the awarding training or research institution. Dissertations must also pass rigorous quality controls, including plagiarism checks, through dedicated national government agencies such as, for the Russian Federation and interestingly also Tajikistan, the Russian Federation Ministry of Education and Science's Highest Attestation Commission.[77] Course-based postgraduate epidemiological study is not required.

Post-Soviet countries have changed their epidemiological training systems in recent times. Firstly, several medical schools (i.e. medical institutes, universities and academies) have reformed their former sanitary-hygienic faculties into public health faculties, now offering reduced clinical, but expanded epidemiology and hygiene (or new public health, including epidemiology) training. Secondly, several schools of public health modelled on successful European or North American schools have been established. For example, in the Russian Federation, St Petersburg's Medical Academy for Postgraduate Studies, in tandem with its Finnish and Swedish partners, and supported by the Soros Foundation, was among the first academic institutions in the country willing to establish a school of public health since 1999. However, the school and its degrees were not recognized nationally.[78] Today, the Northern State Medical University's Arkhangelsk International School of Public Health (http://eng.ispha.ru) founded in 2006 is the only Russian school, whose 120 ECTS-level MPH degrees receive international recognition and (at times) a joint MPH award from the School of Public Health, University of Gothenburg in Sweden. However, in the Russian

Federation a new higher professional educational standard for the Master ('Magistr') of Public Health was settled[79] and MPH programmes are gradually being introduced from 2011. In the Ukraine, the National University of Kyiv-Mohyla Academy's School of Public Health also offers 120 ECTS-level Master in Health Care Management and Public Health degrees since 2004 and is attempting to establish a PhD programme since 2008.

Advanced training for professional epidemiologists is rare in the region. The Training Programs for Epidemiology and Public Health Interventions Network (TEPHINET) (http://www.tephinet.org) provides advanced professional training at EU national centres for surveillance and control of communicable diseases for epidemiologists from EU member states through the European Programs Intervention Epidemiology Training (EPIET) (http://www.tephinet. org/about-tephinet/regions/europe). Israel most frequently and systematically provides advanced training for professional epidemiologists.

Several countries in the region focus their training primarily on public health (or public health care), rather than solely on modern epidemiology. However, such training contributes to a better understanding of epidemiology. The establishment, strengthening and extension of such public health (or public health care) training may be hindered by inconsistencies in national legislation[9,80] stemming from a general hesitation to conceptualize, define and differentiate terms such as 'public health', 'public health care', 'population health' and 'epidemiology'. An example for a country that has made a step towards clarifying epidemiology is the Russian Federation. Epidemiology in this country (and in most other countries of the former Soviet Union) traditionally was and generally still is conceptualized narrowly as the science of communicable disease spread and control.[81–84] However, a new research classification system implemented in the Russian Federation since January 2010 has refined and broadened this traditional understanding by differentiating in its definition of epidemiology between communicable disease and non-communicable disease epidemiology (http://www.aspirantura.spb.ru/pasport/14_02_ 02.html).

The availability and nature of epidemiological textbooks used signals the level of the maturity of epidemiology in a country. The most popular textbook in the EURO I region is Beaglehole and colleagues' *Basic Epidemiology*,[85] first published in 1993 and now in its second edition. Moreover, this textbook has been translated into four official languages of EURO I countries: Bulgarian, Polish, Russian and Turkish (Carla Abou Mrad, WHO Press, personal communication, 21 August 2012). Other popular textbooks include different editions of those by Gerstman,[86] Gordis[87] and Rothman et al.[88] For public health training, many countries in the region use *The New Public Health*.[89] For courses taught in English, Bencko and colleagues' textbook is current.[90] In the Russian Federation, where communicable disease epidemiology dominates, the most popular textbook still is Beliakov and Iafaev's.[91] That local epidemiologists have created an original textbook or dictionary of modern epidemiology in the native language of their country[92–99] suggests an advancement of epidemiological thought and terminology in the country.

The diversity of the region's public health, epidemiology and related training programmes, involved institutions and teaching materials suggests that each EURO I country has its own very specific background characteristics, prerequisites and requirements with respect to the advancement of epidemiology.

## Epidemiological research and funding

The majority of epidemiological research in the region is conducted by universities and government agencies (Supplementary Table 1, available as Supplementary data at *IJE* online). Some research is generally also conducted by specialized non-university research institutes such as the Maria Sklodowska-Curie Memorial Cancer Centre and Institute of Oncology, and the General Karol Kaczkowski Military Institute of Hygiene and Epidemiology in Poland, and the N.N. Blokhin Russian Cancer Research Centre in the Russian Federation. In the countries of the former Soviet Union, epidemiological research was traditionally and still is primarily being conducted by government-funded and affiliated research institutes.

Two factors have vitalized epidemiological and public health research in the region. Firstly, the establishment of some major training and research institutions has notably boosted epidemiological research activity. Prominent institutions established in recent times include the American University of Armenia's College of Health Sciences, Kazakhstan School of Public Health, University of Kyiv-Mohyla Academy's School of Public Health, Faculty of Public Health at the University of Debrecen and Columbia University's Global Health Research Center of Central Asia. Secondly, the collaboration of Eastern European countries in multi-centre studies has made an important contribution to the growth of non-communicable diseases epidemiology in the region.[100] Examples of successful multi-centre studies include the United States National Cancer Institute and EU-funded renal cancer study[101] and the International Agency for Research on Cancer (IARC)-coordinated and EU-funded lung cancer study,[102] which involves 15 centres from six countries (the Czech Republic, Hungary, Poland, Romania, the Russian Federation, Slovakia).

Across Europe, public health (including epidemiological) research experiences serious shortages in government funding.[103] For example, a recent survey poignantly demonstrated that the EU Structural Funds programme prioritized biomedical over public health research for all of the six Eastern European countries participating in the survey (Bulgaria, the Czech Republic, Hungary, Poland, Romania,

Slovakia).[104] Furthermore, between-country differences in research funding are dramatic. For example, whereas Israel dedicated 4.27% of GDP to research and development in 2009, Tajikistan only allocated 0.09%.[25] South-Central Asian countries face the most severe funding shortages.

Major sources of epidemiology/public health research funding are national government agencies such as departments or ministries of health and education; international organizations such as primarily the EU through programmes such as the Research Framework Programme, Structural Funds and Health Programme; other countries through their dedicated institutions; and charitable organizations. To provide one case study of funding sources, the American University of Armenia's College of Health Sciences (http://auachsr.com) has received funding from the national government through the Ministry of Health, Armenian National Center for AIDS Control and Prevention and Armenian National Institute of Health; through international organizations such as the EU, UNICEF, the Global Fund and WHO; through donor countries such as the USA through USAID; through non-governmental organizations such as the American International Health Alliance, American Red Cross, AmeriCares, Jinishian Memorial Foundation, Lions Club International Foundation, United Methodist Committee on Relief and Well Start International; and through foreign universities such as Johns Hopkins University Population Communications Service and the University of Pennsylvania School of Nursing.

Unfortunately, a large proportion of epidemiological research conducted in many countries of the region by professionals identifying as epidemiologists is carried out without mandate by dedicated funding, utilizes low-quality data and lacks methodological rigor.[71,81,84,105,106] Such low-quality and low-validity research has little chance of getting published in leading academic journals. More importantly, however, such research risks bringing epidemiological (and indeed all public health) research into disrepute. It therefore presents a serious threat to the status of epidemiology (and public health) in the region and needs to be tackled.

## Epidemiological societies and journals

The region hosts a large number of professional societies of epidemiology, public health or other relevant disciplines (Table 1). Supplementary Table 2 (available as Supplementary data at *IJE* online) lists 45 societies whose name contains 'epidemiology', 'public health' or related terms, but excludes societies that do not reflect their involvement in epidemiological activities in their names. The list should be regarded as non-comprehensive, because information searches often only retrieved limited information from, for example, societies' organizational websites, and assigned contact persons often did not answer our enquiries.

**Table 1** Number of selected professional societies of epidemiology and related disciplines, their membership, and number of journals of epidemiology and related sciences in the EURO I countries, 2012[a]

| Sub-region/country | Number of societies | Membership | Number of journals |
|---|---|---|---|
| **Eastern Europe** | | | |
| Belarus | 2 | 942 | 1 |
| Bulgaria | 2 | 44 | 1 |
| Czech Republic | 4 | 683 | 6 |
| Hungary | 4 | 612 | 3 |
| Moldova | 3 | 800 | 1 |
| Poland | 7 | 4977 | 5 |
| Romania | 2 | 265 | 0 |
| Russian Federation | 2 | 8500 | 7 |
| Slovakia | 4 | 370 | 1 |
| Ukraine | 1 | 4200 | 5 |
| **Western Asia** | | | |
| Armenia | 2 | 77 | 0 |
| Azerbaijan | 0 | 0 | 0 |
| Cyprus | 1 | 250 | 1 |
| Georgia | 1 | 19 | 0 |
| Israel | 2 | 140 | 1 |
| Turkey | 2 | 900 | 4 |
| **South-Central Asia** | | | |
| Kazakhstan | 3 | 231 | 1 |
| Kyrgyzstan | 1 | 818 | 0 |
| Tajikistan | 1 | N/A | 1 |
| Turkmenistan | 0 | 0 | 1 |
| Uzbekistan | 1 | N/A | 0 |

N/A, not applicable.
[a]More detailed information on societies and journals is given in Supplementary Tables 2 and 3 (available as Supplementary data at *IJE* online).

An especially large number of professional societies exist in Poland and Hungary. Sometimes, societies seem to have been created to accomplish a specific, short-term goal and to vanish shortly after goal completion. Several societies also appear to enumerate their members only approximately, in all likelihood because of vague membership criteria or poor accounting. In Belarus, the Republic of Moldova, the Russian Federation, the Ukraine and South-Central Asian countries, the term 'epidemiology' in societies' names refers explicitly to communicable diseases study and/or control.

The region's only professional society belonging to IEA's European Epidemiology Federation (http://www.iea-europe.org/Board.htm) is the Polish Epidemiological Society. At present, 50 EURO I epidemiologists are IEA members, i.e. 35 from Eastern European and 15 from Western Asian countries. Romania contributes the largest number of IEA members in the region. Nine countries have no IEA members. Six epidemiologists from the region are Society

for Epidemiologic Research members (http://www.epiresearch.org; IEA Membership Coordinator).

We identified 38 peer-reviewed, academic journals with 'epidemiology', 'public health' or related terms in the title (Table 1 and Supplementary Table 3, available as Supplementary data at *IJE* online). Almost all journals with 'epidemiology' in their title are devoted to communicable disease study and/or control. Only four of the identified journals are internationally established to the point that they are MEDLINE-indexed. The newest journal in the region is the biannual *Tobacco Control and Public Health in Eastern Europe,* which started operation in 2011.

### Publication activity

The number of epidemiological publications, which is indicative of the level of epidemiological research activity, has increased in the EURO I countries across all three sub-regions between 1992–2001 and 2002–2011. In absolute numbers, the increase was largest for publications about Eastern European countries (from 240 publications per year in 1992–2001 to 351 publications per year in 2002–2011), followed by publications about Western Asian countries (from 62 to 158), and smallest for those about South-Central Asian countries (from 10 to 13).

Figure 4 presents the number and rate per capita of population of MEDLINE-indexed epidemiological publications about a country from the region. The country that the largest number of publications report about over the 1992–2011 period is the Russian Federation, followed by Poland, Turkey and Israel.

However, a relative measure of the publication activity, the publication rate (number of publications about a country expressed per one million of population of the country), is considerably higher for Israel (83.2), followed by Cyprus (45.5), Hungary (36.8), the Czech Republic (27.5) and Poland (24.9) in 2002–2011. The lowest rate is observed for publications about Turkmenistan and Uzbekistan (both 1.4), followed by Tajikistan (2.3) and Ukraine (3.0). Indeed, it is evident when comparing figures for mortality (Figure 2) and for publication rate (Figure 4), that there is a severe discrepancy between the need for and the actual epidemiological activity by country.

Of the region's epidemiological publications, 79.6% are also produced within the region, i.e. they are principally authored by a researcher affiliated with an institution or written in an official language of a country within the region. A large percentage of epidemiological publications about Eastern European (81.9%) and Western
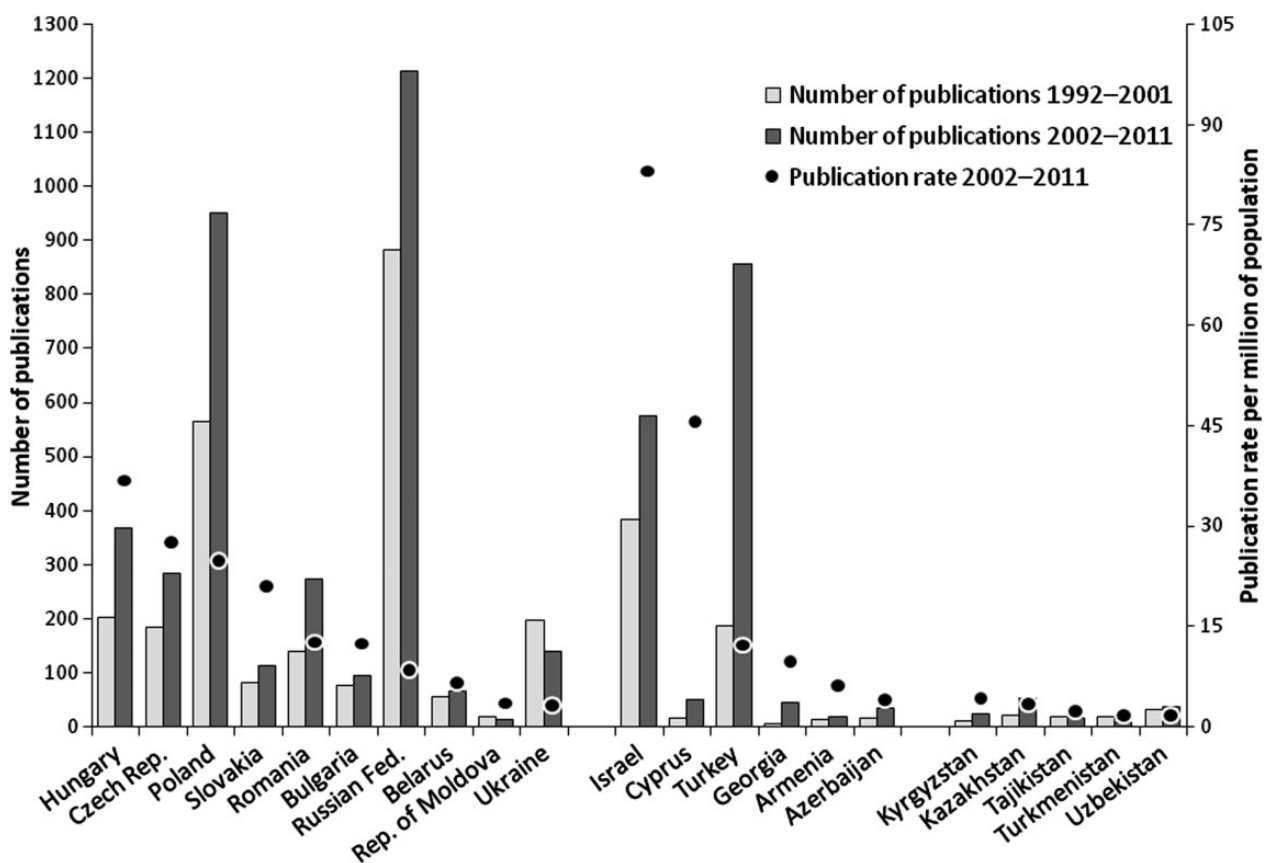


**Figure 4** Number and publication rate of MEDLINE-indexed epidemiological papers for 21 countries of the EURO I region, 1992–2011. Publication rate is defined as the ratio of number of epidemiological papers published in 2002–2011 to population size in 2007, and expressed per one million of population. Countries are aggregated into three groups (Eastern Europe, Western Asia, South-Central Asia) and ordered by decreasing publication rate

Asian countries (66.4%) is principally authored by researchers affiliated with institutions or written in official languages (excluding Azerbaijan) of countries within the respective sub-region (Eastern Europe and Western Asia, respectively); a low percentage originates from countries of other sub-regions (0.0% and 0.4%, respectively). The reverse pattern is observed for publications about South-Central Asian countries, with a low percentage (10.9%) originating from within the sub-region (excluding Russian-language articles) and more than half (54.7%) originating from the other two sub-regions (Eastern Europe, Western Asia). However, allocating Russian-language publications to Eastern Europe, despite Eastern European and South-Central Asian countries sharing Russian as an official language, may have overestimated the percentage of publications originating from Eastern Europe and underestimated those originating from South-Central Asia.

Over half (58.0%) of the regions' epidemiological publications are indexed as referring to conditions classified as one of: communicable diseases and maternal, perinatal and nutritional conditions; non-communicable diseases; and injuries.[14] The percentage of these publications that address communicable diseases and maternal, perinatal and nutritional conditions (42.0%) is higher than the percentile contribution of this disease category to the total burden of disease (13.1%). On the contrary, the share of research outputs on non-communicable diseases (59.2%) is lower than the share of non-communicable diseases to the burden of disease (70.6%). The percentage of epidemiological research activity on injuries matches the percentage contribution of injuries to the burden of disease (16.1% cf. 16.3%). (The sum of percentages exceeds 100, because publications could be indexed in multiple categories). The remaining 42.0% of the publications indexed, e.g. many social epidemiological papers, do not refer to specific diseases/conditions and thus do not fall under one of the three groupings mentioned above.

This bibliometric analysis does not assess the quality of epidemiological publications. It is theoretically possible that some countries may be less research-active and/or produce fewer publications, but may have higher-quality research and/or produce higher-quality publications (as determined e.g. by the number of citations, journal's impact factor or journal's h-index).[107,108]

# Future challenges

The areas that are of ongoing public health concern in the EURO I countries and that epidemiological research should address, include non-communicable diseases such as circulatory system diseases, cancers, obesity and diabetes, but especially also emerging infectious diseases and antibiotic resistance; risk factors such alcohol, tobacco and other drug use; social determinants of health such as especially ageing; and health inequalities.

Without doubt, many EURO I countries continue to be dominated in their general approach to epidemiology by the Semashko model of public health, which fully medicalizes public health, subordinates preventive medicine to therapeutic medicine and conceptually limits epidemiology to the study and/or control of communicable diseases.[46,109] Whereas the institutional split between communicable and non-communicable disease epidemiology exists across Europe,[110] it is particularly obvious in the EURO I countries. Epidemiologists should expand the EURO I countries' understanding of epidemiology as a discipline that studies not only communicable diseases, but also non-communicable diseases, risk factors, the social determinants of health and health inequalities. Current conceptual and definitional ambiguity diminishes the appeal of epidemiology for those considering taking up, specialising in or already practising epidemiology. Not surprisingly, epidemiological capacity-building in the EURO I countries therefore necessarily requires building a shared understanding of epidemiological concepts, definitions and terms. Although conceptual, definitional and terminological work is often disregarded, it is paramount for the development of epidemiology in the region that devoted epidemiologists, biostatisticians and others take up and continue this work.

Modern epidemiology predominantly still is an establishing science in the region's low- and middle-income countries. Epidemiology in these countries faces, besides a narrow conceptualization of the discipline, several miseries including scarcity of undergraduate, postgraduate and advanced professional training programmes; shortages in epidemiological workforce including qualified teachers and senior epidemiologists; funding shortages; and lack of opportunities for driving international collaboration.

Epidemiological capacity-building in the region will remain heterogeneous for some time to come. Progress at the country level will be determined much more by countries' individual historical, social, political and economic conditions and contexts than by advancements that teachers and researchers can make within the epidemiological discipline. However, considering that education and training frameworks and systems are undergoing constant national and international reforms, epidemiologists must continue to ensure the availability of epidemiological (and public health) training. The entire region, with the possible exception of Israel and selected Eastern European countries, should strengthen its advanced professional training opportunities to grow its capacity, to retain its resident epidemiologist and to attract additional senior workforce from other countries. The relatively small number of epidemiological publications about South-Central Asian countries, which are primarily written by epidemiologists from outside this sub-region, calls for urgent building of epidemiological research capacity in this sub-region. International professional organizations such as IEA and TEPHINET could play a key role in capacity-building in the region. Builders of local

capacity should take advantage of the experience already gained.[111]

Much of the value of epidemiological research lies in the information it provides policy-makers for national and international health policy and system development and planning. However, to fulfil this role, first, epidemiological research activity must match information needs; and, second, health data collection systems should not be restructured without a full understanding of epidemiological and public health research and practice needs. As part of ongoing reforms, an implementation of workable e-health systems in the EURO I countries[112–114] presents a noteworthy opportunity for epidemiology, because these systems could potentially provide low-cost, high-quality data as a resource for capacity-building. Currently, only few countries in the region link routinely collected records such as population censuses and disease registers. The reasons are that qualified epidemiologists, biostatisticians and other data analysts are scarce; available data storage and processing systems are insufficient; and national legislation constrains data access. Although complete registers are scarce in the EURO I countries, the lack of application of record-linkage methods presents a lost opportunity. At the same time, avoiding overzealous data protection measures is one of the great challenges facing epidemiologists in the EURO I countries during the early 21st century. Such measures will potentially harm the operation and, therefore, the completeness and overall quality of disease registers and/or prevent epidemiologists from accessing the register data altogether.[115]

It is recognized that the present paper inevitably may miss some issues that are important for an individual country, but too difficult to be generalized within the context of the region. This should encourage local epidemiologists to include in their mission list the task of writing a detailed overview of population health and standing of epidemiology in their home countries.

## Supplementary Data

Supplementary data are available at *IJE* online.

**Conflict of interest:** None declared.

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### KEY MESSAGES

- Epidemiological training and research in the EURO I region is marked by ongoing national and international structural reforms aiming to modernize and harmonize educational and research frameworks and systems.

- Health data collection systems should not be restructured and personal data protection legislation should not be developed and implemented without a full understanding of epidemiological and public health research and practice needs.

- Other key challenges include conceptualizing and defining epidemiology; securing advanced professional training, high-quality data and knowledge of advanced analysis methods; and strengthening epidemiology, particularly in South-Central Asian countries.

# References

1 United Nations Department of Economic and Social Affairs. *Demographic Yearbook 2008*. Issue 16. New York: United Nations, 2010.

2 The World Bank. *Country and Lending Groups*. Washington: The World Bank, 2011. http://data.worldbank.org/about/country-classifications/country-and-lending-groups (5 January 2013, date last accessed).

3 The World Bank. *World Development Indicators & Global Development Finance*. Washington: The World Bank, 2012. http://data.worldbank.org/topic (5 January 2013, date last accessed).

4 United Nations Department of Economic and Social Affairs. *World Population Prospects: The 2010 Revision*. New York: United Nations, 2011. http://esa.un.org/wpp/unpp/panel_population.htm (5 January 2013, date last accessed).

5 Kvitsinadze L, Tvildiani D, Pkhakadze G. HIV/AIDS prevalence in the Southern Caucasus. *Georgian Med News* 2010; **12:**26–36.

6 Overall JW, Goodman J. The roles of non-governmental organizations in development of schools of public health: an example from Eastern Europe and Central Asia. *Public Health Rev* 2011;**33:**168–89.

7 Tulchinsky TH, Varavikova EA. Addressing the epidemiologic transition in the former Soviet Union: strategies for health system and public health reform in Russia. *Am J Public Health* 1996;**86:**313–20.

8 Djibuti M, Gotsadze G, Mataradze G, Menabde G. Human resources for health challenges of public health system reform in Georgia. *Hum Resour Health* 2008;**6:**8.

9 Armenian HK, Crape B, Grigoryan R, Martirosyan H, Petrosyan V, Truzyan N. *Analysis of Public Health Services in Armenia*. Yerevan, Armenia: American University of Armenia, 2009.

10 Gotsadze G, Chikovani I, Goguadze K, Balabanova D, McKee M. Reforming sanitary-epidemiological service in Central and Eastern Europe and the former Soviet Union: an exploratory study. *BMC Public Health* 2010;**10:**440.

11 Maier CB, Martin-Moreno JM. Quo vadis SANEPID? A cross-country analysis of public health reforms in 10 post-Soviet states. *Health Policy* 2011;**102:**18–25.

12 Balabanova D, Roberts B, Richardson E, Haerpfer C, McKee M. Health care reform in the former Soviet Union: beyond the transition. *Health Serv Res* 2012;**47:**840–64.

13 Curado MP, Edwards B, Shin HR *et al*. (eds). *Cancer Incidence in Five Continents, Vol. IX*. IARC Scientific Publications No. 160. Lyon, France: IARC, 2007.

14 World Health Organization. *The Global Burden of Disease: 2004 Update*. Geneva: World Health Organization, 2008.

15 World Health Organization. *Global Health Observatory (GHO). Age-standardized DALY's per 100 000 by Cause and Member State, 2004*. Geneva: Department of Measurement and Health Information, World Health Organization, 2009. Available at http://www.who.int/entity/healthinfo/global_burden_disease/gbddeathdalycountryestimates2004.xls (5 January 2013, date last accessed).

16 World Health Organization. *Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks*. Geneva: World Health Organization, 2009. http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf (5 January 2013, date last accessed).

17 European Centre for Disease Prevention and Control (ECDC)/World Health Organization Regional Office for Europe. *HIV/AIDS Surveillance in Europe 2010*. Stockholm: ECDC, 2011.

18 World Health Organization. *Global Information System on Alcohol and Health (GISAH)*. Geneva: World Health Organization, 2011. http://apps.who.int/ghodata/?theme=GISAH (5 January 2013, date last accessed).

19 World Health Organization. *Global Tuberculosis Control: WHO Report 2011*. Geneva: World Health Organization, 2011.

20 World Health Organization. *World Health Statistics 2012*. Geneva: World Health Organization, 2012. http://www.who.int/healthinfo/EN_WHS2012_Full.pdf (5 January 2013, date last accessed).

21 European Commission. *Eurobarometer 72.3. EU Citizens' Attitudes Towards Alcohol*. Brussels: TNS Opinion & Social, 2009. http://ec.europa.eu/public_opinion/archives/ebs/ebs_331_en.pdf (5 January 2013, date last accessed).

22 European Monitoring Centre for Drug and Drug Addiction. *Statistical Bulletin 2011: Table DRD-5: Mortality Due to Drug-Induced Deaths in European Countries, in All Adults and Adults Aged 15 to 39 Years (Total and Males)*. Lisbon: EMCDDA, 2011. http://www.emcdda.europa.eu/stats11/drdtab5a (5 January 2013, date last accessed).

23 United Nations Scientific Committee on the Effects of Atomic Radiation. *Sources and Effects of Ionizing Radiation. UNSCEAR 2008 Report to the General Assembly, with Scientific Annexes, Vol. II*. New York: United Nations, 2011.

24 Hibell B, Guttarmson U, Ahlström SW *et al*. *The 2011 ESPAD Report: Substance Use Among Students in 36 European Countries*. Stockholm: The Swedish Council for Information on Alcohol and Other Drugs, 2012. http://www.espad.org/Uploads/ESPAD_reports/2011/The_2011_ESPAD_Report_FULL_2012_10_29.pdf (5 January 2013, date last accessed).

25 UNESCO, Institute for Statistics; Table 26. *GERDN as a Percentage of PGP and GERD per Capita, 2009*. Montreal: UIS, 2012. http://stats.uis.unesco.org/unesco (5 January 2013, date last accessed).

26 Blakely T, Pega F, Nakamura Y, Beaglehole R, Lee L, Tukuitonga CF. Health status and epidemiological capacity and prospects: WHO Western Pacific Region. *Int J Epidemiol* 2011;**40:**1109–21.

27 Barreto SM, Miranda JJ, Figueroa JP *et al*. Epidemiology in Latin America and the Caribbean: current situation and challenges. *Int J Epidemiol* 2012;**41:**557–71.

28 Dhillon PK, Jeemon P, Arora NK *et al*. Status of epidemiology in the WHO South-East Asia region: burden of disease, determinants of health and epidemiological research, workforce and training capacity. *Int J Epidemiol* 2012;**41:**847–60.

29 Cockerham WC. The intersection of life expectancy and gender in a transitional state: the case of Russia. *Sociol Health Illn* 2012;**34:**943–57.

30 Anderson BA, Silver BD. Trends in mortality of the Soviet population. *Sov Econ* 1990;**6:**191–251.

31 Shkolnikov V, Mesle F, Vallin J. Health crisis in Russia. I. Recent trends in life expectancy and causes of death from 1970 to 1993. *Population* 1996;**8:**123–54.

32 Shkolnikov V, McKee M, Leon DA. Changes in life expectancy in Russia in the mid-1990s. *Lancet* 2001;**357:**917–21.

33 Leon DA. Trends in European life expectancy: a salutary view. *Int J Epidemiol* 2011;**40:**271–77.

34 Botev N. Population ageing in Central and Eastern Europe and its demographic and social context. *Eur J Ageing* 2012;**9:**69–79.

[35] Rahu M. Cancer epidemiology in the former Soviet Union. *Epidemiology* 1992;**3**:464–70.

[36] Badurashvili I, McKee M, Tsuladze G, Meslé F, Vallin J, Shkolnikov V. Where there are no data: what has happened to life expectancy in Georgia since 1990? *Public Health* 2001;**115**:394–400.

[37] Aleshina N, Redmond G. How high is infant mortality in Central and Eastern Europe and the Commonwealth of Independent States? *Popul Stud* 2005;**59**:39–54.

[38] Akgün S, Çolak M, Bakar C. Identifying and verifying causes of death in Turkey: National verbal autopsy survey. *Public Health* 2012;**126**:150–58.

[39] Jargin SV. Health care and life expectancy: A letter from Russia. *Public Health* 2012;**127**:189–90.

[40] Rechel B, McKee M. The effects of dictatorship on health: the case of Turkmenistan. *BMC Med* 2007;**5**:21.

[41] Finegold JA, Asaria P, Francis DP. Mortality from ischaemic heart disease by country, region, and age: Statistics from World Health Organization and United Nations. *Int J Cardiol* 2012; doi: 10.1016/j.ijcard.2012.10.046.

[42] Rajaratnam JK, Marcus JR, Flaxman AD *et al*. Neonatal, postneonatal, childhood, and under-5 mortality for 187 countries, 1970–2010: a systematic analysis of progress towards Millennium Development Goal 4. *Lancet* 2010; **375**:1988–2008.

[43] Carlson E, Hoffmann R. The state socialist mortality syndrome. *Popul Res Policy Rev* 2011;**30**:355–79.

[44] Shkolnikov VM, Cornia GA, Leon DA, Meslé F. Causes of the Russian mortality crisis: evidence and interpretations. *World Dev* 1998;**28**:1995–2011.

[45] Cockerham WC, Hinote BP, Abbott P. Psychological distress, gender, and health lifestyles in Belarus, Kazakhstan, Russia, and Ukraine. *Soc Sci Med* 2006;**63**:2381–94.

[46] Zatoński WA, HEM project team. Epidemiological analysis of health situation development in Europe and its causes until 1990. *Ann Agric Environ Med* 2011;**18**:194–202.

[47] Leon DA, Saburova L, Tomkins S *et al*. Hazardous alcohol drinking and premature mortality in Russia: a population based case-control study. *Lancet* 2007;**369**:2001–09.

[48] Zaridze D, Brennan P, Boreham J *et al*. Alcohol and cause-specific mortality in Russia: a retrospective case-control study of 48 557 adult deaths. *Lancet* 2009;**373**: 2201–14.

[49] Heyns B. Emerging inequalities in Central and Eastern Europe. *Annu Rev Sociol* 2005;**31**:163–97.

[50] von dem Knesebeck O, Verde PE, Dragano N. Education and health in 22 European countries. *Soc Sci Med* 2006;**63**: 1344–51.

[51] Mackenbach JP, Stirbu I, Roskam AJ *et al*. Socioeconomic inequalities in health in 22 European countries. *N Engl J Med* 2008;**358**:2468–81.

[52] Leinsalu M, Stirbu I, Vågerö D *et al*. Educational inequalities in mortality in four Eastern European countries: divergence in trends during the post-communist transition from 1990 to 2000. *Int J Epidemiol* 2009;**38**:512–25.

[53] Slachtová H, Tomásková H, Splíchalová A, Polaufová P, Fejtková P. Czech socio-economic deprivation index and its correlation with mortality data. *Int J Public Health* 2009;**54**:267–73.

[54] Todorova I, Baban A, Alexandrova-Karamanova A, Bradley J. Inequalities in cervical cancer screening in Eastern Europe: perspectives from Bulgaria and Romania. *Int J Public Health* 2009;**54**:222–32.

[55] Türkkan A, Aytekin H. Socioeconomic and health inequality in two regions of Turkey. *J Community Health* 2009;**34**:346–52.

[56] Jaffe DH, Neumark YD, Eisenbach Z, Manor O. Educational inequalities in mortality among Israeli Jews: changes over time in a dynamic population. *Health Place* 2010;**16**:242–51.

[57] Stirbu I, Kunst AE, Bopp M *et al*. Educational inequalities in avoidable mortality in Europe. *J Epidemiol Community Health* 2010;**64**:913–20.

[58] Kohler IV, Preston SH. Ethnic and religious differentials in Bulgarian mortality, 1993–98. *Popul Stud* 2011;**65**: 91–113.

[59] Rosicova K, Madarasova Geckova A, van Dijk JP, Kollarova J, Rosic M, Groothoff JW. Regional socioeconomic indicators and ethnicity as predictors of regional infant mortality rate in Slovakia. *Int J Public Health* 2011; **56**:523–31.

[60] Bessudnov A, McKee M, Stuckler D. Inequalities in male mortality by occupational class, perceived status and education in Russia, 1994–2006. *Eur J Public Health* 2012;**22**:332–37.

[61] Marek M, Chłoń-Domińczak A, Kaleta D *et al. Social Inequalities in Health in Poland*. Copenhagen: WHO Regional Office for Europe, 2012. http://www.euro.who.int/__data/assets/pdf_file/0008/177875/E96720.pdf (5 January 2013, date last accessed).

[62] Nagy C, Juhász A, Beale L, Páldy A. Mortality amenable to health care and its relation to socio-economic status in Hungary, 2004–08. *Eur J Public Health* 2012;**22**: 620–24.

[63] Sözmen K, Baydur H, Şimşek H, Ünal B. Decomposing socioeconomic inequalities in self assessed health in Turkey. *Int J Equity Health* 2012;**11**:73.

[64] Petrov AN. Lost generations? Indigenous population of the Russian North in the post-Soviet era. *Can Stud Popul* 2008;**35**:269–90.

[65] Sepkowitz KA. Health of the world's Roma population. *Lancet* 2006;**367**:1707–08.

[66] Ginter E, Simko V, Wsolova L. Fall of the iron curtain: male life expectancy in Slovakia, in the Czech Republic and in Europe. *Cent Eur J Public Health* 2009; **17**:171–74.

[67] Chernichovsky D, Anson J. The Jewish-Arab divide in life expectancy in Israel. *Econ Hum Biol* 2005;**3**: 123–37.

[68] Bobak M, McKee M, Rose R, Marmot M. Alcohol consumption in a national sample of the Russian population. *Addiction* 1999;**94**:857–66.

[69] Popova S, Rehm J, Patra J, Zatoński W. Comparing alcohol consumption in central and eastern Europe to other European countries. *Alcohol Alcohol* 2007;**42**: 465–73.

[70] Pomerleau J, McKee M, Rose R, Haerpfer CW, Rotman D, Tumanov S. Hazardous alcohol drinking in the former Soviet Union: a cross-sectional study of eight countries. *Alcohol Alcohol* 2008;**43**:351–59.

[71] Balonov MI. On protecting the inexperienced reader from Chernobyl myths. *J Radiol Prot* 2012;**32**:181–89.

[72] Tauch C, Rauhvargers A. *Survey on Master Degrees and Joint Degrees in Europe*. Geneva: European University Association, 2002. http://www.eua.be/eua/jsp/en/upload/Survey_Master_Joint_degrees_en.1068806054837.pdf (5 January 2013, date last accessed).

[73] Davies H. *Survey of Master Degrees in Europe*. Brussels: European University Association, 2009. http://www.eua.be/Libraries/Publications_homepage_list/EUA_Survey_Of_Master_Degrees_In_Europe_FINAL_www.sflb.ashx (5 January 2013, date last accessed).

74 Education, Audiovisual and Culture Executive Agency. *The European Higher Education Area in 2012: Bologna Process Implementation Report*. Brussels: Education, Audiovisual and Culture Executive Agency, 2012. http://www.bolognaexperts.net/sites/default/files/ehea_2012_bologna_implementation_report_0.pdf (5 January 2013, date last accessed).

75 Neumark Y, Manor O, Berry EM. Promoting public health workforce training for developing and transitional countries: fifty-year experience of the Braun School of Public Health and Community Medicine, Jerusalem, Israel. *Public Health Rev* 2011;**33**:251–63.

76 Abazov R. Science in Turkmenistan: How far will reforms go? *CACI Analyst* 2009;**11**:3–5. http://www.cacianalyst.org/files/090715Analyst.pdf (5 January 2013, date last accessed).

77 Osipian AL. Economics of corruption in doctoral education: the dissertations market. *Econ Educ Rev* 2012;**31**:76–83.

78 Kamper-Jørgensen F. *Evaluation of Swedish and Finnish Economic Support to St. Petersburg School of Public Health*. Final Report, 2003. http://stphs.narod.ru/Claes/FinnKamperReportMay1st.htm (5 January 2013, date last accessed).

79 Russian Education: Federal Portal. *The Federal State Educational Standard of Higher Professional Education for 060400 'Public health' (a Master's degree)*. Moscow: State Research Institute of Information Technology and Telecommunication, 2012. [In Russian.] http://www.edu.ru/db-mon/mo/Data/d_09/prm800-1.pdf (5 January 2013, date last accessed).

80 WHO Regional Office for Europe. *Self-assessment of Public Health Services in the Republic of Uzbekistan*. Technical Report. Tashkent, Uzbekistan: Ministry of Health of the Republic of Uzbekistan, 2011. http://www.euro.who.int/__data/assets/pdf_file/0003/148377/PHSS_report_MAH.pdf (5 January 2013, date last accessed).

81 Vlassov V. Is there epidemiology in Russia? *J Epidemiol Community Health* 2000;**54**:740–44.

82 McKee M. Monitoring health in central and eastern Europe and the former Soviet Union. *Soz.-Präventivmed* 2005;**50**:1–3.

83 Sergiev VP. Thoughts on the occasion of the appearance of the V. V. Vlassov's book ''Epidemiology'' or an effort to philosophically write an informal review. *Zh Mikrobiol Epidemiol Immunobiol* 2006;**6**:110–13. [In Russian].

84 Piekkala A. Challenges of public health education in the former Soviet Union: example of Ukraine. *TCPHEE* 2012;**2**:67–76.

85 Beaglehole R, Bonita R, Kjellström T. *Basic Epidemiology*. Geneva: WHO, 1993.

86 Gerstman BB. *Epidemiology Kept Simple: An Introduction to Traditional and Modern Epidemiology*. 2nd edn. New York: Wiley-Liss, 2003.

87 Gordis L. *Epidemiology*. 4th edn. Philadelphia, PA: Saunders, 2009.

88 Rothman KJ, Greenland S, Lash TL. *Modern Epidemiology*. 3rd edn. Philadelphia, PA: Lippincott Williams & Wilkins, 2008.

89 Tulchinsky TH, Varavikova EA. *The New Public Health: An Introduction for the 21st Century*. 2nd edn. Amsterdam: Elsevier Academic Press, 2009.

90 Bencko V, Holcátová I, Králíková E *et al*. *Hygiene and Epidemiology: Selected Chapters*. Prague: Karolinum Press, 2011.

91 Beliakov VD, Iafaev RKh. *Epidemiology*. Moscow: Meditsina, 1989. [In Russian].

92 Gülesen Ö. *Çağdaş Epidemiyoloji [Modern Epidemiology]*. Bursa: Uludağ University, 1995. [In Turkish].

93 Modan B. *Epidemiology*. 2nd edn. Tel Aviv: Papyrus, 1996. [In Hebrew].

94 Bencko V, Frintová K, Holcátová I *et al*. *Epidemiologie*. Prague: Karolinum Press, 2002. [In Czech].

95 Bencko V, Hrach K, Malý M *et al*. *Biomedicínská statistika III. Statisticke metody v epidemiologii. [Biomedical Statistics III. Statistical Methods in Epidemiology]*. Prague: Karolinum Press, 2003. [In Czech].

96 Jędrychowski W. *Podstawy epidemiologii: metody badań oraz materiały ćwiczeniowe [Basics of Epidemiology: Methods of Research and Training Materials]*. Kraków: Jagellonian University, 2002. [In Polish].

97 Hajdú Piroska V, Ádány R (eds). *Epidemiológiai szótár [Dictionary of Epidemiology]*. Budapest: Medicina Könyvkiadó Rt, 2003. [In Hungarian].

98 Vlassov VV. *Epidemiology*. Moscow: Geotar-Med, 2004. [In Russian].

99 Shipkovenska E, Hristov J, Dimitrov P, Diakova M. *Modern Epidemiology and Evidence-Based Medicine*. Sofia: Filvest, 2008. [In Bulgarian].

100 Bencko V. Use of epidemiological data for cancer risk assessment: Approaches, concepts, and issues. *Open Epidemiol J* 2011;**4**:94–98.

101 Karami S, Brennan P, Hung RJ *et al*. Vitamin D receptor polymorphisms and renal cancer risk in Central and Eastern Europe. *J Toxicol Environ Health A* 2008;**71**:367–72.

102 Olsson AC, Gustavsson P, Zaridze D *et al*. Lung cancer risk attributable to occupational exposures in a multi-center case-control study in Central and Eastern Europe. *J Occup Environ Med* 2011;**53**:1262–67.

103 Conceição C, Leandro A, McCarthy M. National support to public health research: a survey of European ministries. *BMC Public Health* 2009;**9**:203.

104 McCarthy M. Public health research support through the European structural funds in central and eastern Europe and the Mediterranean. *Health Res Policy Syst* 2012;**10**:12.

105 Andreeva TI. Surveys used to assess the population health and to inform healthy public policy: challenges for research in poor countries. *TCPHEE* 2012;**2**:1–4.

106 Vlassov VV, Danishevskiy KD. Biomedical journals and databases in Russia and Russian language in the former Soviet Union and beyond. *Emerg Themes Epidemiol* 2008;**5**:15.

107 Braun T, Glänzel W, Schubert A. Hirsch-type index for journals. *Scientometrics* 2006;**69**:169–73.

108 Rajesh R, Rajeev K, Ragesh NK, Gopakumar V. Measures for the quality of individual articles, authors and journals. *Int J Comput Appl* 2010;**9**:1–4.

109 Ádány R, Villerusa A, Bislimovska J, Kulzhanov M. Public health education in Central and Eastern Europe, and Central Asia. *Public Health Rev* 2011;**33**:105–33.

110 Saracci R. Epidemiological concepts pre-1950 and their relation to work in the second half of the century. In Holland WW, Olsen J, Florey C, du V (eds). *The Development of Modern Epidemiology: Personal Reports from Those Who Were There*. New York: Oxford University Press, 2007.

111 Andruchow JE, Soskolne CL, Racioppi F, Bertollini R. Capacity building for epidemiologic research: a case

study in the newly independent state of Azerbaijan. *Ann Epidemiol* 2005;**15:**228–31.

112 Moisil I, Jitaru E. E-health progresses in Romania. *Int J Med Inform* 2006;**75:**315–21.

113 Duplaga M. E-health development policies in new member states in Central Europe. *World Hosp Health Serv* 2007;**43:** 34–38.

114 Sass M, Feko A. The emergence of telemedicine and e-health in Hungary. *Telemed J E Health* 2011;**17:**388–95.

115 Micheli A, Baili P. Information on cancer. In Coleman MP, Alexe D-M, Albreht T, McKee M (eds). *Responding to the Challenge of Cancer in Europe*. Ljubljana, Slovenia: Institute of Public Health, 2008.