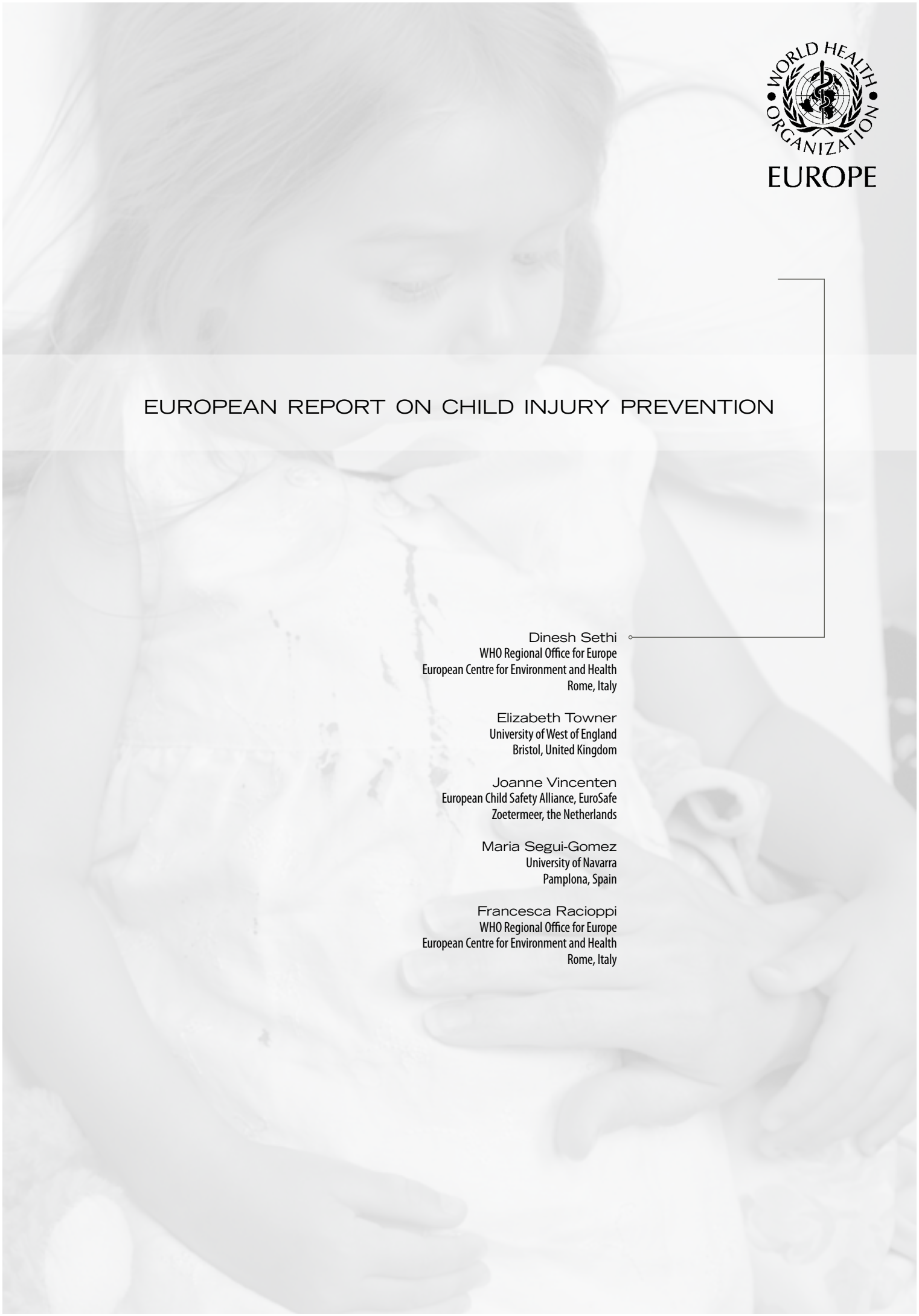
WORLD HEALTH ORGANIZATION
EUROPE

EUROPEAN REPORT ON CHILD INJURY PREVENTION



WORLD HEALTH ORGANIZATION
EUROPE

EUROPEAN REPORT ON CHILD INJURY PREVENTION

Dinesh Sethi
WHO Regional Office for Europe
European Centre for Environment and Health
Rome, Italy

Elizabeth Towner
University of West of England
Bristol, United Kingdom

Joanne Vincenten
European Child Safety Alliance, EuroSafe
Zoetermeer, the Netherlands

Maria Segui-Gomez
University of Navarra
Pamplona, Spain

Francesca Racioppi
WHO Regional Office for Europe
European Centre for Environment and Health
Rome, Italy

European report on child injury prevention.

Abstract
Injuries are a leading cause of death and disability in children. This report presents evidence on how they can be prevented, and calls for greater commitment and action from policy-makers and practitioners to decrease the burden of injuries. Every year, nearly 42 000 children and teenagers aged 0–19 years die from unintentional injuries in the European Region, where injuries are the leading cause of death in children aged 5–19; 5 out of 6 of these deaths occur in low- and middle-income countries. Irrespective of country income, the burden falls disproportionately on children from the most disadvantaged groups. The leading mechanisms of unintentional injury death in children are road traffic crashes, drowning, poisoning, thermal injuries and falls. Whatever the mechanism, the main causes of injury and their underlying socioeconomic and environmental determinants are similar. Children are particularly vulnerable to injuries, and need special consideration to safeguard their right to health and to a safe environment, free from injury. The evidence base for prevention programmes is presented in this report. Health systems and in particular child health programmes throughout the European Region should prioritize child injury prevention and control.

Keywords
1. Wounds and injuries – prevention and control
2. Accident prevention
3. Child welfare
4. Socieconomic factors
6. Europe

Address requests about publications of the WHO Regional Office for Europe to:
Publications
WHO Regional Office for Europe
Scherfigsvej 8
DK-2100 Copenhagen Ø, Denmark
Alternatively, complete an online request form for documentation, health information, or for permission to quote or translate, on the Regional Office web site (http://www.euro.who.int/pubrequest).

Authors:

Dinesh Sethi	WHO Regional Office for Europe, European Centre for Environment and Health, Rome, Italy
Elizabeth Towner	University of West of England, Bristol, United Kingdom
Joanne Vincenten	European Child Safety Alliance, EuroSafe, Zoetermeer, the Netherlands
Maria Segui-Gomez	University of Navarra, Pamplona, Spain
Francesca Racioppi	WHO Regional Office for Europe, European Centre for Environment and Health, Rome, Italy

Photo credits:
K. Brown: pp. 42
M. Gallitto: pp. 31
Istockphoto: pp. XIII, XIV, 14, 24, 29, 38, 48, 58 / backgrounds pp. I, X, 47, 57 / cover
M. Sledák: pp. 24
N. Di Tanno: pp. XIII, 22, 28
WHO/Europe: pp. 3

Design and layout: L'IV Com Sàrl, Morges, Switzerland
Printed in Rome, Italy, by Stabilimenti Tipografici Carlo Colombo

ACRONYMS

APOLLO	Strategies and Best Practices for the Reduction of Injuries
APSI	Portuguese Association for Child Safety Promotion
CEHAPE	Children's Environment and Health Action Plan for Europe
CIS	Commonwealth of Independent States
DALY	disability-adjusted life-year
ECMT	European Conference of Ministers of Transport
EC	European Commission
EU	European Union (27 countries)
EuroSafe	European Association for Injury Prevention and Safety
GBD	Global Burden of Disease (WHO study)
GDP	Gross Domestic Product
HIC	High-income countries
HFA-DB	WHO health for all database
HFA-MDB	WHO health for all mortality database for 67 causes
HFA-DM	WHO health for all detailed mortality database
ICD	WHO International Classification of Diseases
ICD-9	ICD, ninth revision
ICD-9 BTL	ICD-9 basic tabular list
ICD-10	ICD, tenth revision
ILO	International Labour Organization
LMIC	low- and middle-income countries
MKD	The former Yugoslav Republic of Macedonia
NGO	nongovernmental organization
PFD	personal flotation device
RAPEX	Rapid alert system for non-food consumer products
RTI	road traffic injury
RoSPA	Royal Society for the Prevention of Accidents
SMR	standardized mortality rate
UNECE	United Nations Economic Commission for Europe
UNICEF	United Nations Children's Fund

ACKNOWLEDGEMENTS

Many international experts and WHO staff have contributed to the development of this book, and we are very thankful for their support and guidance. We are particularly grateful to the following WHO staff:

- Birte Frerick and Francesco Mitis for their help with the data analysis and to Enrique Loyola for providing advice and the European detailed mortality database;
- Margie Peden for sharing the *World report on child injury prevention* and for thorough and patient comments on several drafts;
- Kidist Bartholomeos for thorough and patient comments on drafts;
- Vivian Barnekow for providing very useful comments;
- Mathias Braubach, Leda Nemer and Francesco Zambon and for help with contributions to sections of the book;
- Francesca Giampieri and Nicoletta Di Tanno for help in obtaining references and photographs; and
- Manuela Gallitto for administrative support.

We are particularly grateful to our external peer reviewers for their very helpful comments, and for contributing to improving the completeness and accuracy of this publication:

- Morag Mackay, European Child Safety Alliance, EuroSafe, Zoetermeer, the Netherlands
- Rosa Gofin, Hedassah – Hebrew University, Jerusalem, Israel
- Jo Sibert, Cardiff, United Kingdom
- Philippe Lunetta, University of Helsinki, Finland
- Kenn Dunn, International Burn Injury Database, Manchester, United Kingdom
- Nicola Christie, University of Surrey, Guildford, United Kingdom
- David Ormandy, University of Warwick, United Kingdom
- Ian Roberts, London School of Hygiene and Tropical Medicine, United Kingdom
- Eleni Petridou and Evi Germeni, Athens University Medical School, Greece
- Ian Scott, TASC (The Alliance for Safe Children), Vietnam

We are grateful to the following experts for contributing examples of promising injury prevention programmes in the Region:

- Box 1.1: Lucie Laflamme, Karolinska Institutet, Stockholm, Sweden
- Box 1.2: Morag MacKay, European Child Safety Alliance, EuroSafe, Zoetermeer, the Netherlands
- Box 3.4: Richard Kimberlee, University of the West of England, United Kingdom
- Box 3.5: Department for Transport, London.
- Box 4.2: Coby Draisma, Consumer Safety Institute, Zoetermeer, the Netherlands
- Box 4.4: Bernard Basset, Institut national de prévention et d'éducation pour la santé, Paris, France
- Box 4.4: Gainel Ussatayeva, Kazakhstan School of Public Health, Almaty, Kazakhstan.
- Box 5.3: Fatima Rato, Instituto Nacional de Emergência Médica, Lisbon, Portugal
- Box 7.2: David Ormandy, University of Warwick, United Kingdom;
- Box 7.3: Helena Menezes, Portuguese Association for Child Safety (APSI), Portugal

Many other experts also contributed valuable information for the report:

- Iva Truellova, Ministry of Health of Czech Republic
- Veronika Benešová, Centre for Injury Prevention of the Charles University, Czech Republic
- Jana Feldmane, Ministry of Health of Latvia
- Biruté Strukcinskiene, Faculty of Health Sciences of the Klaipeda University, Lithuania
- Gregória Paixão von Amann, Directorate-General of Health, Ministry of Health of Portugal

- Sharon Goldman, The Israeli National Center for Trauma and Emergency Medicine Research and The Gertner Institute for Epidemiology and Health Policy Research
- Alexandre von Kessel, Federal Office of Public Health at the Division of International Affairs, Switzerland
- Maria Giuseppina Lecce, Ministry of Social Affairs and Health of Italy
- E.F. Van Beeck, University Medical Centre Rotterdam, the Netherlands
- Gudula Brandmayr, Grosse schützen Kleine/Safe Kids Austria, Graz, Austria
- Michael Watson, University of Nottingham, United Kingdom
- Radushkevich V.L., Chursin A.A. in Voronezh, Russian Federation, Voronezh
- Phil Edwards, London School of Hygiene and Tropical Medicine, United Kingdom
- Liri Endy Findling, Safe Kids Israel – Beterem, Petach-Tikva, Israel
- Francisco J Lopez-Valdés, University of Navarra, Pamplona, Spain
- Alejandro Ramirez and Maria José Carroquino, Institute of Health Carlos III of the Ministry of Health and Consumer Affairs of Spain
- Huib Valkenberg,Consumer Safety Institute in the Netherlands, Zoetermeer, the Netherlands
- Florence Weil, Consumer Safety Institute, Paris, France
- Martine Abel, Bundesarbeitsgemeinschaft (BAG) Mehr Sicherheit für Kinder e.V. (Federation of Association for Greater Safety for Children), Bonn, Germany
- Natalie Norman and Mathilde Sengölge, EuroSafe, Zoetermeer, the Netherlands
- Gabriella Páll, National Institute of Child Health, Budapest, Hungary
- Rupert Kisser and Robert Bauer, Kuratorium für Verkehrssicherheit (KfV), Vienna, Austria
- Tania Vandenberghe, The European Voice in Consumer Standardisation (ANEC), Brussels, Belgium

Finally we wish to thank Nedret Emiroglu, Acting Director, Division of Health Programmes, WHO Regional Office for Europe, for her encouragement and support.

This report is a companion to the *World report on child injury prevention*. Dinesh Sethi is the editor in chief. Elizabeth Towner and Francesca Racioppi contributed to the editing. Authorship of the chapters is as follows:

Chapter 1: Dinesh Sethi, Elizabeth Towner and Francesca Racioppi
Chapter 2: Dinesh Sethi and Maria Segui-Gomez
Chapter 3: Maria Segui-Gomez, Dinesh Sethi and Francesca Racioppi
Chapter 4: Joanne Vincenten and Elizabeth Towner
Chapter 5: Dinesh Sethi
Chapter 6: Elizabeth Towner and Dinesh Sethi
Chapter 7: Joanne Vincenten
Chapter 8: Elizabeth Towner, Dinesh Sethi and Francesca Racioppi
Annexes: Dinesh Sethi and Maria Segui-Gomez

The World Health Organization wish to thank the Government of the Netherlands for their generous support.

Dinesh Sethi, Elizabeth Towner, Joanne Vincenten, Maria Segui-Gomez and Francesca Racioppi

CONTENTS

ACKNOWLEDGEMENTS IV

FOREWORD XI

EXECUTIVE SUMMARY XII
- Road traffic injury XIII
- Drowning XIII
- Poisoning XIII
- Thermal injuries XIV
- Falls XIV
- The way forward XIV
- Conclusion XV

1. OVERVIEW: CHILD INJURIES IN THE WHO EUROPEAN REGION 1
- 1.1 Introduction 1
- 1.2 The concept of childhood and why children need special attention 1
- 1.3 Reason to focus on child injuries in the European Region 1
- 1.4 A changing Region with social inequalities 2
- 1.5 Injury prevention: an issue of social and environmental justice in the European Region 2
- 1.6 Global and European policy initiatives 3
- 1.7 Overcoming the problem 4
- 1.8 Defining a child and an injury 5
- 1.9 References 5

2. BURDEN OF UNINTENTIONAL INJURIES 7
- 2.1 Introduction 7
- 2.2 Variations in the burden 7
- 2.3 Leading causes of injury 9
- 2.4 Variations by age and sex 9
- 2.5 Inequalities in the Region by country income 10
- 2.6 Beyond fatal injuries 10
- 2.7 The burden of injuries 12
- 2.8 Costs of injuries in children 12
- 2.9 Conclusions 12
- 2.10 References 13

3. ROAD TRAFFIC INJURIES 15
- 3.1 Introduction 15
- 3.2 Burden in the Region 15
  - 3.2.1 Mortality 15
  - 3.2.2 Sociopolitical and economic change in the Region 17

3.2.3 Changing patterns of transport and exposure 17
3.2.4 Socioeconomic determinants 19
3.2.5 Gender 19
3.2.6 Morbidity 19
3.2.7 Psychological and social effects 20
3.2.8 Costs 20
3.3 Risk factors for RTIs 20
3.4 What can be done 22
3.4.1 Societal responsibility 22
3.4.2 Community awareness 23
3.4.3 Improving road design 24
3.4.4 Speed 24
3.4.5 Alcohol 24
3.4.6 Child car restraints, seat-belts and seating position 24
3.4.7 Helmets 24
3.4.8 Conspicuity 25
3.5 Conclusions 25
3.6 References 25

4. DROWNING 29
4.1 Introduction 29
4.2 Burden in the Region 29
4.2.1 Mortality 29
4.2.2 Morbidity 31
4.3 Why children are at risk 31
4.3.1 Socioeconomic determinants 32
4.3.2 Economic change 32
4.3.3 Tourism 32
4.3.4 Medical conditions 32
4.3.5 Supervision 32
4.3.6 Alcohol 32
4.3.7 Transport 32
4.3.8 Climate change 32
4.4 Prevention 33
4.4.1 Engineering and environmental approaches 33
4.4.2 Legislation and standards 34
4.4.3 Education and skill development 34
4.4.4 Measures to avoid 35
4.5 Conclusions 35
4.6 References 35

5. POISONING 39
5.1 Introduction 39
5.2 Burden in the Region 39
5.2.1 Mortality 39
5.2.2 Morbidity 39
5.2.3 Costs 41
5.3 Risk factors 41
5.3.1 Age and gender 41
5.3.2 Poisonous agents 41
5.3.3 Socioeconomic determinants and association with poverty 42
5.3.4 Characteristics of the agent 42
5.3.5 Storage of chemicals 42
5.3.6 Seasonal variation 42
5.4 Prevention 43
5.4.1 Environmental modification 43
5.4.2 Engineering approaches 43
5.4.3 Legislative approaches 43
5.4.4 Educational approaches 44
5.4.5 Poison control centres and health care 44
5.4 Conclusions 45
5.5 References 45

6. THERMAL INJURIES 49
6.1 Introduction 49
6.2 Burden in the Region 49
6.2.1 Mortality 51
6.2.2 Morbidity 51
6.2.3 Costs 51
6.3 Risk factors 51
6.3.1 Age 51
6.3.2 Gender 52
6.3.3 Environmental factors 52
6.3.4 Tobacco and alcohol 52
6.3.5 Supervision 52
6.3.6 Socioeconomic determinants and association with poverty 52
6.3.7 Medical conditions and "outsider" status 52
6.3.8 Fireworks 52
6.3.9 Ultraviolet radiation exposure through tourism 52
6.3.10 Fire disasters 53
6.4 WHAT CAN BE DONE 53
6.4.1 Design and other engineering measures 53
6.4.2 Environmental modifications 53
6.4.3 Legislative approaches 53
6.4.4 Educational approaches 54
6.4.5 First aid for thermal injuries 54
6.4.6 Management of burns 54
6.4.7 Intersectoral action 54
6.5 Conclusions 54
6.6 References 55

7. FALLS 59
7.1 Introduction 59
7.2 Burden in the Region 59
7.2.1 Mortality 59
7.2.2 Morbidity 61
7.2.3 Costs 61
7.3 Risk factors 61
7.3.1 Age, developmental stage and gender 62
7.3.2 Environments 62
7.3.3 Consumer products 62
7.3.4 Playground equipment 62
7.3.5 Contact with animals 62
7.3.6 Poverty 63
7.3.7 Supervision 63
7.3.8 Work environments 63
7.4 What can be done 63
7.4.1 Environmental and engineering approaches 63
7.4.2 Legislation and standards 64
7.4.3 Combined strategies 64
7.5 Conclusions 64
7.6 References 65

8. CONCLUSIONS AND POINTS FOR ACTION 67
8.1 Cross-cutting themes 67
8.1.1 Diversity 67
8.1.2 Change 67
8.1.3 Vulnerability 67
8.1.4 Child rights 68
8.1.5 Social determinants and poverty 68
8.1.6 Intersectoral action 69
8.1.7 Prevention and control 69
8.1.8 Potential lives saved 70
8.2 The way forward 71
8.2.1 Action points 71
8.3 Conclusion 72
8.4 References 72

WHY CHILDREN NEED SPECIAL ATTENTION

FOREWORD

Injuries are the leading cause of death in children aged 5–19 years in the WHO European Region, and send many millions of children to hospitals or emergency departments, possibly leading to lifelong disabilities. Injuries thus pose a huge drain on the resources of not only health systems but also society at large. The burden is unequally distributed in the Region, with most of it falling on low- and middle-income countries. Regardless of the level of country income, a disproportionate share of the burden of injuries falls on children from deprived backgrounds and minority groups. For many households, the loss is not just limited to a child's pain and suffering; death or disability can be crippling both psychologically and financially. This inequity in child injury in Member States across the European Region is a cause of social injustice that needs to be addressed.

Some Member States' successes in reducing child mortality from injuries show that many of these deaths, and many injuries, could be prevented. If all countries in the Region matched the performance of the safest, nearly 3 out of 4 injury deaths could be prevented, along with many more non-fatal injuries and disabilities. These figures show the urgent need to take action to address this problem.

Mounting a response to injuries requires more than one sector, and the lack of ownership and leadership of the task has led to fragmented activity and a lack of coordination. A wealth of evidence indicates that the way forward is to use a combination of approaches: environmental modification, engineering of safer products, legislation to require these changes and education to stress the importance of using safety equipment.

Organized effort by society can prevent childhood injury, but this requires strong and sustained commitment across all levels of government and society, as well as the necessary resources, capacity and policy frameworks for effective multidisciplinary action. By giving child injury prevention greater priority, Member States will join a global effort to reduce a leading cause of child mortality, and creating a safer and more just society for children in the European Region.

We at the WHO Regional Office for Europe hope that this report, which accompanies the *World report on child injury prevention*, will be used across the European Region to highlight the magnitude of the problem and support policy-makers, professionals and activists in mainstreaming the child injury prevention agenda both within and outside the health sector.

Marc Danzon
WHO Regional Director for Europe

EXECUTIVE SUMMARY

Injuries are a leading public health threat to children in the WHO European Region. Many children die or experience pain and disability from injury throughout the Region. Children are especially vulnerable to injuries. They need special consideration to safeguard their right to health and to a safe environment, free from injury and violence, as emphasized by the United Nations Convention on the Rights of the Child. Every society is responsible for ensuring that this fundamental right is fulfilled.

This report highlights that injuries are a leading cause of death and disability among children, presents evidence on how injuries can be prevented and calls for greater commitment and action among policy-makers and practitioners to decrease the burden of injuries. This report is a companion document to the *World report on child injury prevention* and focuses on the European dimension of the problem.

Unintentional injuries are the leading cause of death among children aged 5–19 years. In 2004, 42 000 children and adolescents aged 0–19 years died from unintentional injuries in the WHO European Region. But the impact of injuries is much greater, with millions of hospitalizations and emergency care visits. Although injuries are a leading cause of the burden of disease and seriously drain health and societal resources, they have not been a high-priority area for action in most countries until recently. A catastrophic event such as a train crash may capture the public's attention, but the daily loss of lives of 115 children killed by injuries in Europe is scarcely noticed. The largest loss of life in the Region is in low- and middle-income countries, where five of six of deaths from injury among children occur. The countries with the highest and lowest death rates from unintentional injury in the Region differ sevenfold. The low- and middle-income countries in the European Region have undergone rapid socioeconomic and political change, and the higher injury mortality is associated with this pace of change.

The leading mechanisms of death from unintentional injury in children are road traffic crashes, drowning, poisoning, thermal injuries and falls. For all mechanisms, the main causes of injury and their underlying socioeconomic and environmental determinants are strikingly similar. The burden falls disproportionately on the most disadvantaged children and on the countries undergoing the greatest socioeconomic change. Death rates from unintentional injury among children vary by as much as nine times by socioeconomic stratum in some countries. This unequal distribution of injuries threatens to further widen the gap in inequality in health between and within countries and causes social injustice. Nevertheless, several European countries have been successful in developing comprehensive and evidence-based approaches to preventing injury and rank among the safest countries in the world. This experience is a valuable resource for the Region and shows that strong and sustained commitment can result in major progress. It serves to encourage all countries to engage in addressing this preventable cause of premature death and suffering, thereby reducing inequality in society.

This report discusses five leading mechanisms for unintentional injury among children in the Region.

Road traffic injury

Throughout the Region, road traffic injuries are the leading mechanism of fatal injuries. They are also a leading cause of traumatic brain and limb injuries, resulting in long-term disability among children. Travelling is an essential component of the daily lives of children on their way to school, home and play. Children need special consideration because they are vulnerable and inexperienced road users. In 2004, an estimated 16 400 children and adolescents aged 0–19 years died from road traffic injuries. The rates vary in the Region, with a threefold difference between the countries with the highest and lowest death rates. Children living in low- and middle-income countries have a 1.6-fold increased risk of dying from road traffic injury compared with children in high-income countries. Children from deprived backgrounds are at increased risk, especially as pedestrians and cyclists, because of exposure to unsafe environments. Unsafe road design, speed, excessive alcohol and failure to use safety devices are the leading risk factors.

If all countries in the Region had the same mortality rates as those with the lowest rates, then the lives of nearly 7900 children could be saved each year: that is, half the deaths from this cause among children could be averted. Countries that have had considerable success in road safety have shown that preventing road traffic injuries requires action by different actors and the integration of safety measures into broader transport and urban development policies. In addition to safer road design and controlling speed and alcohol use, effective measures include using seat-belts, helmets, child car restraints, cycle lanes and pedestrianized areas. Providing safe environments for children reduces road traffic injury, and a transport policy that promotes cycling and walking has other health and environmental benefits. These include reducing obesity and reducing noise and emissions, which reduce the risk of ill health from noncommunicable disease and mitigate climate change. The overall benefits of integrated programmes for safety thus go well beyond reducing injury. Failure to safeguard children who use the roads compromises children's fundamental right to safety. This challenge presents an opportunity to acknowledge society's responsibility to its children and to tackle the problem using structural and community-based interventions that will provide effective solutions for everyone regardless of background or income.

Drowning

Drowning is the second leading cause of injury deaths among children in the WHO European Region and the leading cause of childhood injury death in some countries. Each year, more than 5000 children and adolescents aged 0–19 years die from drowning in the Region. In addition, children who are injured by drowning may be severely disabled through brain damage and require lifelong financial and health care support. As in other mechanisms of injury, inequality is substantial, and the mortality rates between the countries in the Region with the highest and lowest rates differ by twentyfold. This inequality is also striking within countries, where the poorest people are more vulnerable to death from drowning by up to 11 times.

Water environments should be positive and beneficial for both children and adults, and undertaking preventive action to enhance safety is therefore essential. If mortality rates were the same as those in the countries with the lowest rates, then 90% of these deaths among children could be averted. This emphasizes the very great potential for prevention. Such action needs to be intersectoral to ensure safe water environments using the combined approaches of engineering and modifying the environment, legislation and education. Proven interventions to reduce drowning among children include removing or covering water hazards, installing four-sided pool fencing, using personal flotation devices and instituting immediate resuscitation.

Poisoning

Poisoning remains the third leading cause of unintentional injury death; 3000 children and adolescent aged 0–19 years died from acute poisoning in 2004 in the Region. Inequality is substantial in the Region both between countries and within countries. The countries with the highest and lowest rates differ by thirtyfold, and 90% of poisoning deaths occur in the low- and middle-income countries in the Region. The home is the most common setting for childhood poisoning, and children are particularly at risk when harmful substances are stored in non-child-proof containers or within easy reach. In the Region, pharmaceuticals, household agents, pesticides and plants cause most cases of fatal poisoning. Acute intoxication with alcohol among older children is a growing concern.

If all countries in the Region had the same rate as the country with the lowest rate, then 93% of deaths could be averted. Evidence from countries with low rates shows that modifying the environment, such as child-resistant closures, safe storage, reducing the availability of toxic substances, dispensing medicines in non-lethal quantities and establishing poison control centres, is a good investment in prevention. However, obstacles remain in further reducing the incidence and morbidity of poisoning. To ensure coordinated action, national plans for preventing poisoning need to be developed that include these interventions. Targeted action to reduce acute alcohol intoxication among children is also needed.

Thermal injuries

Thermal injuries are a leading cause of death and disfigurement among children. Each year, 1700 children aged 0–19 years die from thermal injuries in the Region, and many of those who survive thermal injuries are permanently scarred or disabled. Inequality is substantial between and within countries in the Region: the death rates in the countries with the highest and lowest rates differ by 85 times. Within countries, the poorest people are more vulnerable by up to 38 times. Deaths and injuries resulting from thermal injuries are strongly linked to unsafe environments and products, especially in the home.

Many cost-effective strategies exist to prevent burns among children, and 90% of deaths could be averted if the rates were the same as those in the countries with the lowest rates. Thermal injuries can be prevented or controlled by a variety of measures, including legislation and regulations, modifying the environment and educating people and raising awareness. Such a response needs to involve a range of stakeholders from diverse sectors, including community members. Laws to enforce the installation of smoke alarms and to regulate hot water and standards for cigarette lighters are effective in preventing thermal injuries and need to be implemented widely. First aid initiatives and providing high-quality burn care are effective in ensuring the best possible outcomes for physical and mental health and need to be supported widely.

Falls

Falls occur frequently and can have a tremendous effect on children, families and society. Each year more than 1500 children aged 0–19 years die from falls in the Region. Countries differ vastly in rates, and the death rates between the countries with the highest and lowest rates differ by a factor of 22. Falls are the leading cause of the burden of injuries among children younger than 15 years and are the most common cause of fatal and serious head injuries among young children. Children from socioeconomically deprived backgrounds have an increased risk of fatal and nonfatal injuries, and this inequity needs to be addressed.

Up to 90% of fall deaths in the Region could be averted if mortality rates were the same as those in the countries with the lowest rates. Successful prevention programmes from these countries can also provide useful lessons in settings with fewer resources. Creating and managing safe environments and products for children are critical in reducing their exposure to and risk of serious falls. Proven strategies exist to reduce serious falls among children and include modifying or replacing unsafe products, requiring window guards, implementing playground standards and executing multifaceted community programmes.

The way forward

This report highlights the enormous scale of the loss to society from injury among children in the WHO European Region and the huge potential for prevention by addressing underlying risks and exposures. If all countries in the Region had the same injury mortality rates among children as the countries with the lowest rates, this would avoid an estimated 75% of these deaths. The experience accumulated by several European countries shows that sustained and systematic approaches that address the underlying causes of injuries, such as their socioeconomic and environmental determinants, can make all countries in the Region among the safest in the world. Several action points are recommended for taking this forward. Global and European policy developments underpin this action.

1. **Provide leadership in integrating the prevention of injury among children and adolescents into a comprehensive approach to their health and development**. A comprehensive strategy for the health and development of children and adolescents needs to include injury because it is a leading cause of death and disability among children. This report provides evidence of effective action, and integrating this into a comprehensive approach will optimize health gain.
2. **Develop and implement a policy and plan for preventing injury among children that involves other sectors**. Intersectoral activities are essential for successfully preventing injury and key to a plan for preventing injury among children. Efforts should include sectors of government, the private sector, nongovernmental organizations, the mass media and the general public, with a clear allocation of responsibilities and resources. The strategy should include all children, especially those in low-income and ethnic minority communities. Such a strategy should be coordinated with the promotion of physical activity through walking, cycling and swimming in safe environments and the safe use of public transport. A comprehensive policy framework would also overcome the fragmented approach to preventing injury.

3. **Implement evidence-based action to prevent and control injuries among children**. There is sufficient evidence to start implementing the specific actions needed to prevent and control injuries among children and to minimize their consequences. Key approaches need to include legislation, regulation and enforcement, modifying products, modifying the environment, education and developing skills and emergency health care.
4. **Strengthen health systems to address injuries among children**. Health system responses need to incorporate both primary prevention and the provision of high-quality emergency trauma care to injured children as well as rehabilitation and support services. The principles of equity and evidence-based practice should underpin these actions. Focal people for injury prevention within health ministries are well placed to coordinate such activities.
5. **Build capacity and exchange best practice**. An essential part of an adequate health system response is ensuring sufficient trained and experienced staff. Curricula that focus on preventing injury need to be integrated into health professional curricula. Exchanging knowledge by developing partnerships and networks strengthens country capacity. Children and adolescents need to be included and actively involved in programmes and research, and injury prevention activities should be introduced into school and university curricula.
6. **Enhance the quality and quantity of data for preventing injury among children**. Good data on mortality, morbidity, exposure, outcomes and costs are needed to provide a foundation on which to develop and monitor policies that promote child safety. Most countries need better information on the circumstances and activities surrounding an injury and the socioeconomic determinants, which are essential to understanding exposure and risk and to developing comprehensive responses.
7. **Define priorities for and support research and evaluation on the causes, effects, costs and prevention of injury among children**. A research agenda for injuries among children needs to be developed at the regional and national levels. Research skills should be strengthened in a variety of injury-related fields, including epidemiology, economics, engineering, social sciences, human factor and behavioural psychology, product evaluation, clinical trials and policy analysis.
8. **Raise awareness and targeted investment for preventing injury among children**. Raising awareness about the ability to prevent injury among children is of paramount importance. Promoting safer environments for children is a crucial part of this. To do this, health systems need to advocate for safer broad government policy on ensuring safer physical and social environments.
9. **Address inequity in injury among children**. The health sector has a key role to play in advocating for just action across government and can do this by promoting equity in health in all policies and by highlighting injuries as a consequence of social policies. Further, the health sector needs to incorporate the prevention of injury in its provision of universal primary health care and support of community-based action and needs to pay particular attention to targeting the social stratification of injuries.

Conclusion

Achieving greater social justice in the WHO European Region requires eliminating inequity in injuries among children. The greatest burden of injury in the Region is concentrated in low- and middle-income countries, with rates of injury mortality among children more than three times greater than in high-income countries. In high-income countries, deprived communities bear a disproportionately higher share of the burden. Nevertheless, few countries have devoted adequate resources to preventing unintentional injuries among children and adolescents. Societies have a responsibility to protect children and adolescents by providing safe environments. Programmes on children's health throughout the Region must ensure that they include preventing and controlling injury among children. This important problem requires attention, commitment, resources and action now.

WHY CHILDREN NEED SPECIAL ATTENTION

CHAPTER 1
OVERVIEW: CHILD INJURIES IN THE WHO EUROPEAN REGION

1.1 Introduction

Across the length and breadth of the WHO European Region, injuries kill children or leave them in pain or with disabilities. No country is immune from this problem, but the rates of fatal and non-fatal injury vary widely, reflecting the diverse conditions in the Region. The main causes of injury and their underlying socioeconomic and environmental determinants, however, are strikingly similar. The burden falls disproportionately on children from the most disadvantaged groups and in the countries undergoing the greatest socioeconomic change. This unequal distribution of injuries threatens to further widen the gap in health inequalities between and within countries, and causes social injustice. Nevertheless, several European countries have developed comprehensive and evidence-based approaches to injury prevention, and rank among the safest in the world. This experience is a valuable resource for the Region, showing that strong and sustained commitment can result in major progress. This could encourage all countries to address this preventable cause of premature death and suffering, thereby reducing inequalities in society.

This report is a companion to the *World report on child injury prevention (1)* and focuses on the European dimension of the issue. It therefore highlights the importance of injuries as a leading cause of death and disability in children in the WHO European Region, presents evidence on how they can be prevented and calls for greater action from policy-makers and practitioners to decrease the burden.

This first chapter examines the burden; describes inequalities, the social determinants of injuries and the risk factors; and presents some of the evidence on what works for prevention. Chapter 2 focuses on the overall burden from all injuries and sets the scene for the Region. The subsequent chapters describe the burden and deal with preventing the leading unintentional injury causes. The final chapter summarizes the evidence and calls on policy-makers, practitioners and researchers from all sectors to protect Europe's children from this public health threat using solutions based on the best evidence.

1.2 The concept of childhood and why children need special attention

This report examines injuries in children and adolescents aged 0–17 years. The concept of childhood varies between cultures, and is influenced not only by age and developmental stage but also by gender, family and social background, school and work *(2,3)*. This needs to be taken into account when exposures, risk factors and the development of injury prevention strategies are considered for different settings in the Region.

This report focuses on children because they are not small adults. Childhood encompasses different stages of emotional, physical and brain development, ranging from newborn babies to adolescents. Injuries require a different response at each stage *(4)*.

As children do not have a platform for expressing their views, they need advocates of safer environments on the road, at leisure and in the home. Environments are better adapted to the needs of adults than children, and children may not know how to respond appropriately to risky situations. Policy-makers and practitioners need to take account of these special circumstances when promoting safety for this vulnerable group. Failure to do so compromises the fundamental rights of children and young adults to safety and full and productive lives, in accordance with the United Nations Convention on the Rights of the Child *(5)*. It is unjust that children largely bear the external costs of injuries. They have a right to safe environments, and this right may be denied in segments of society or whole countries.

1.3 Reason to focus on child injuries in the European Region

Injuries affect people of all ages, but they are the leading cause of death in those aged 5–17 years in the WHO European Region. They are also a major cause of pain, suffering and disability, which can have far-reaching consequences for children's physical, psychological and social development. Further, child injuries are a huge drain on health and societal resources in the short and longer terms *(6,7)*.

Only in the last few decades have injuries been recognized as a problem that coordinated public health action can prevent. Thinking has shifted to accept injury prevention as a societal responsibility and to recognize that evidence-based systemic prevention is a more effective response than regarding injuries as random and unavoidable accidental events modifiable through education. The health sector can play a central role in this new approach by documenting the burden, distilling the evidence of what works, prioritizing actions and engaging other sectors in partnerships to develop prevention plans.

Countries in the Region vary widely in circumstances and culture. For example, some western and northern Member States have showed strong and sustained political commitment and allocated resources to tackle child injury over a number of years; these have some of the lowest injury rates in the world. In contrast, central and eastern countries, including the Commonwealth of Independent States (CIS), are adjusting to rapidly changing political, economic and social realities and have very high child injury rates.

Thus, the societal commitment and concerted public health action that result in safer environments and behaviour do not benefit all children in the Region. This report aims to stimulate action that will make the less privileged as safe as those in the most privileged societies. Plenty of opportunities are available for strengthening collaboration, so that good practice can be adapted and transferred from one country to another, as well as to different segments of society *(8,9)*.

1.4 A changing Region with social inequalities

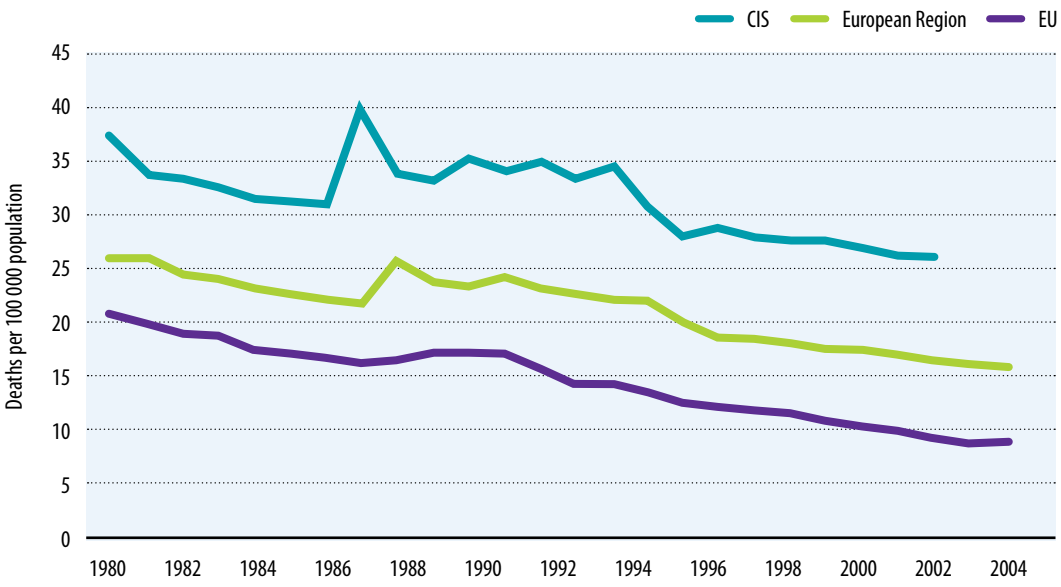
Countries in the Region not only are diverse but also change rapidly. All feel the effects of globalization, with material and social environments coming under new stresses. These stresses are felt unevenly, however, and increasing evidence indicates that the losers in this process are falling behind. Health inequalities are rising in the most vulnerable groups, with children foremost among them. Inequalities in child mortality from injury have widened in many countries and are a barometer of this change. This is an issue of social justice, and equal opportunities for safe environments should be ensured throughout the whole Region.

Change is nowhere more visible than in the low- and middle-income countries (LMICs) in the Region. They are undergoing both political change and rapid transition to market economies. Political and social uncertainty has caused increased stress for families. High inflation, unemployment and poverty, rising income inequality and social disintegration, exacerbated by some of the highest alcohol consumption levels in the world, have increased exposure to risk and weakened the safety and support networks that mitigate the effects of injuries *(10–14)*. These changes contributed to a peak in child injury mortality in the early 1990s (Fig. 1), with the subsequent decline attributed to the relative price increase of alcohol and decrease of motor traffic linked to the economic slowdown in some transition countries *(14)*. Today, unintentional injury mortality rates in the CIS, although declining, remain three times higher than those in the European Union (EU).

1.5 Injury prevention: an issue of social and environmental justice in the European Region

As a matter of social and environmental justice, all countries in the WHO European Region should address the link between poverty, inequality and injuries *(16)*. The Tallinn Charter: Heath Systems for Health and Wealth *(17)*, adopted by the Region's Member States in 2008, promotes the values of solidarity, equity and participation through health policies and resource allocation, and calls for attention to be paid to the needs of the poor and vulnerable groups. The United Nations Children's Fund (UNICEF) stated that: "Poverty compromises children's lives and has a cumulative and negative impact on their future" *(18)*. Socioeconomic

Figure 1.1
Trends in standardized mortality rates for unintentional injury in children aged 1–19 years in the WHO European Region



Source: Mortality by 67 causes of death, age and sex *(15)*.

class and poverty are intertwined with physical, social, psychological, educational and occupational variables, as well as social capital and social networks *(19–22)*. All these influence the patterns of and consequences of injury (see Box 1.1).

In the 20 countries in south-eastern Europe and the CIS, 1 in 4 children lives in absolute poverty, and children have a higher probability of being poor than adults. Poverty is concentrated in some regions: more than half the child populations in central Asia, the Caucasus and the Republic of Moldova live in poverty *(18)*.

Poor children may be exposed to hazardous environments – including fast traffic, lack of safe play areas and crowded homes with unsafe structures such as stairs without rails or gates or windows without bars and locks *(20)*. Poor families may not be able to afford safety equipment, such as child car restraints, smoke alarms or bicycle helmets *(11)*. Supervision may be difficult in families headed by one parent or where parents have conflicting demands on their time and no adequate child-care facilities. Once injured, poor children may have less access to high-quality medical and rehabilitation services. The costs of health care and lost earning capacity may severely damage a family's financial position *(22)*. Further, children in rural areas may be at greater risk of road traffic injuries (RTIs), drowning, fires and contact with pesticides *(24)*.

Certain groups may face multiple disadvantages and thus be particularly vulnerable to injuries, including the Roma community, displaced people and refugees *(25)*. The Roma community is one of Europe's largest and most vulnerable minorities. Many Roma children live in overcrowded and dilapidated housing and are forced to work to help their families survive *(26)*.

Another concern in the Region is that of children at work. Young workers run a higher risk of injuries arising from lack of experience, limited awareness of existing or potential risks, or immaturity *(27)*. Working methods, tools and equipment are normally designed for adults, and do not take account of child workers' smaller size *(28)*.

Child labour is a relatively underreported issue, and reliable information about the number of child workers in the Region is lacking *(28)*. Child labour, however, can result in deaths and injuries and loss of opportunities for education and social development. Unacceptable working conditions can include exposure of young workers to hazards at coal mines, farms and construction sites. Children often perform work that is regarded as helping out, in domestic settings, seasonal jobs and street trading *(28)*.

BOX 1.1

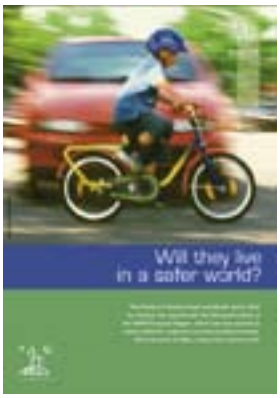
Recent findings of a systematic review of injury inequalities

Childhood injuries show some of the steepest social gradients in mortality in the WHO European Region. Studies from Greece, Ireland, Spain, Sweden, the Netherlands and the United Kingdom demonstrate that children from less affluent areas suffer and die from injuries much more than their more affluent peers. Studies of the mechanisms contributing to this social patterning show that one of the major risk factors is the unsafe home, play and road environments of children in deprived areas. This contributes greatly to the risk differentials in death and injuries.

Making children's environments inherently safer by using passive safety countermeasures can reverse the social inequities in injury. These interventions tackle the physical exposures that put children at risk. For example, ameliorating material deprivation at home by providing better housing and modifying the traffic environment to ensure that children are not exposed to dangerous situations have been shown to result in fewer injuries, thereby reducing the safety differentials between different social groups.

Policy-makers and opinion leaders are increasingly concerned that the current trend in social inequalities in health constitutes a major threat to health. In particular, existing health targets, such as those for improved life expectancy and reduced child mortality, may not be achieved. Equity-oriented policies and interventions have been proposed as responses. Safety for all is their cornerstone, and they should be enacted within and outside the health sector *(23)*.

1.6 Global and European policy initiatives



Injuries are increasingly recognized to be a preventable cause of premature death, but countries in the Region vary widely in the patterns of policies and initiatives for child injury prevention, ranging from intense activity to limited commitment. As early as 1960, the WHO Regional Office for Europe recognized injuries as the leading cause of childhood death in Europe *(29)*.

Since then, four World Health Assembly resolutions have emphasized the public health approach to preventing injuries, and called on Member States to take action. These resolutions include children as one of the target groups for intervention:

- 1996: resolution WHA49.25 on prevention of violence: a public health priority *(30)*
- 1997: resolution WHA50.19 on prevention of violence *(31)*
- 2003: resolution WHA56.24 on implementing the recommendations of the World report on violence and health *(32)*
- 2004: resolution WHA57.10 on road traffic safety and health *(33)*.

The United Nations Convention on the Rights of the Child *(5)* underlines the social responsibility to protect children up to the age of 18 years and to provide them with appropriate support and services. It therefore supports children's right to health and a safe environment, free from injury and violence. The fourth of the Millennium

Development Goals adopted by the General Assembly of the United Nations, calls for a two-thirds reduction in mortality in children under 5 years between 1990 and 2015 *(34)*. Although it does not mention injuries, this target will only be achieved if concerted efforts are made to reduce injury mortality, as it is one of the leading causes of death in children over 1 year of age.

In Europe, Regional Priority Goal II of the Children's Environment and Health Action Plan for Europe (CEHAPE) focuses on injuries as a leading cause of preventable death from environmental factors *(35)*, and the European strategy for child and adolescent health and development *(36)* highlights the need for prevention. WHO Regional Committee for Europe resolution RC55/R9 calls on Member States to take concerted public health action to reduce death and disability from injuries in the European Region *(37)*. Similarly, the European Commission (EC) consultation on a recommendation to the Council on the prevention of injuries and promotion of safety *(38)* singles out groups, including children, that require greater attention.

Increasingly rapid dissemination of ideas and knowledge in public health *(39)* can strengthen people's ability to avoid injury. The growth of a global civil society *(40)* with networks of formal and informal groups can influence health issues where national structures may be weak: examples include the International Society for Child and Adolescent Injury Prevention, the European Child Safety Alliance, the European Academy of Paediatrics and the Safe Communities movement (Box 1.2). Other organizations have a global governance role, such as UNICEF, the International Labour Organization (ILO) and nongovernmental organizations (NGOs), including the International Federation of Victims of Traffic Injuries. NGOs at the country level may coordinate and stimulate injury prevention activities. Examples include the Child Accident Prevention Trust in the United Kingdom and the Portuguese Association for Child Safety Promotion.

1.7 Overcoming the problem

Injuries result from a complex interaction between the individual and the physical and social environment. As mentioned, thinking has shifted from focusing on the individual to emphasizing the societal responsibility to provide inherently safer environmental contexts to prevent injuries from occurring. The scope for intervention therefore involves different sectors – including NGOs, academia and industry – concerned with ensuring safer domains, exposures and behaviour. Injury prevention (Box 1.3) therefore requires a systematic approach.

Experience from the countries with the best safety records shows that positive leadership, along with widespread efforts to provide safer physical and social environments, can result in sustained reductions in injury mortality and morbidity *(10)*, as well as health inequalities. Sweden was the first to recognize the importance of injuries as a threat to child health and to tackle the problem in a coordinated manner; it sustained this commitment over 50 years *(42)*. Swedish society's sense of corporate responsibility meant that a culture of safety could be nurtured and the protection of children became a major societal goal. The implementation of effective interventions around the European Region would

BOX 1.3

Preventing injuries

Injury prevention involves primary, secondary and tertiary prevention. Primary prevention aims to prevent the injury event in the first place through, for example, stair gates to prevent falls or drink–driving legislation to reduce the risk of road traffic injury. Secondary prevention seeks to reduce the risk of injury once an event has occurred. A smoke alarm will not prevent a fire but may enable occupants to escape a building before they are overcome by smoke or burned. Tertiary prevention aims to minimize the consequences of an injury, for example, by providing first aid and emergency trauma care.

BOX 1.2

Collective action in Europe to develop and implement national child safety action plans

As injury is the leading cause of death for children in every Member State in the European Region, having a government-endorsed plan to address this critical health issue is an essential step in meeting children's rights to safety. More than 30 countries are developing such plans within the framework of the Child Safety Action Plan initiative, led and coordinated by the European Child Safety Alliance of the European Association for Injury Protection and Safety Promotion (EuroSafe), with the support of the EC, WHO and UNICEF. This European project is undertaking joint action and uses standard indicators and other tools to assess the state of child injury in participating countries, identify gaps and priority issues, and select evidence-based good practices to outline multisectoral plans with clear commitments and action steps.

The assessments undertaken by each country form the basis of national-level child safety report cards and profiles, which allow benchmarking in and between countries at baseline and as implementation proceeds. Seeking participation and endorsement from the governments of each country is designed to enhance plan uptake and gain further commitment to leadership, infrastructure and capacity commensurate with the size of the issue.

Participating countries are making progress, with several now implementing plans, and all have indicated that the process has placed child injury higher on the political agenda and led to a more coordinated approach to child injury prevention for those that have moved beyond the assessment stage.

Further information is available from EuroSafe *(41)*.

save many thousands of lives and considerable amounts in health care costs.

This report examines the prevention of five major injury types: traffic, drowning, burns, falls and poisoning. For each type, evidence indicates that a range of different approaches – legislation, regulation and enforcement, product and environmental modification, education and skills development, and emergency medical care – can prevent or reduce the impact of injuries.

1.8 Defining a child and an injury

This report follows Article 1 of the United Nations Convention on the Rights of the Child in defining a child as any human being below the age of 18 *(5)*. However much of the data presented in this report are for children and adolescents aged 0–19 years because existing data sources provide information in this age group.

An injury is the physical damage that occurs when the human body is suddenly subjected to amounts of energy that exceed the physiological threshold or is deprived of vital elements such as oxygen. The energy can be mechanical, thermal, chemical or radiant *(43)*. Injuries are usually defined by intention. The main causes of unintentional injuries, the focus of this report, are road traffic injuries, poisoning, drowning, falls and burns.

1.9 References

1. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization (in press).
2. Tamburlini G. Children's special vulnerability to environmental health hazards: an overview. In Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002 (Environmental Issue Report 29).
3. Lansdown G. The evolving capacities of the child. Florence, UNICEF Innocenti Research Centre, 2005 (http://www.unicef-irc.org/publications/pdf/evolving-eng.pdf, accessed 28 October 2008).
4. Aynsley-Green A et al. Who is speaking for children and adolescents and for their health at policy level. *BMJ*, 2000, 321:229–232.
5. *Convention on the Rights of the Child*. New York, NY, United Nations, 1989 (A/RES/44/25) (http://www.unhchr.ch/html/menu3/b/k2crc.htm, accessed 28 October 2008).
6. Krug E, Sharma G, Lozano R. The global burden of injuries. *American Journal of Public Health*, 2000, 90:523–526.
7. Sethi D, et al. Reducing inequalities from injuries in Europe. *Lancet*, 2006, 368:2243–2250.
8. Brussoni M, Towner E, Hayes M. Evidence into practice: combining the art and science of injury prevention. *Injury Prevention*, 2006,12(6):373–377.
9. Forjuoh S, Guohua, L. A review of successful transport and home injury interventions to guide developing countries. *Social Science and Medicine*, 1996, 43(11):1551–1560.
10. Sethi D et al. *Injuries and violence in Europe: why they matter and what can be done*. Copenhagen, WHO Regional Office for Europe, 2006 (http://www.euro.who.int/document/E88037.pdf, accessed 28 October 2008).
11. Towner E. Injury and inequalities: bridging the gap. *International Journal of Injury Control and Safety Promotion*, 2005;12:79–84.
12. *Transition. The first ten years: analysis and lessons for eastern Europe and the former Soviet Union*. Washington, DC, World Bank, 2002.
13. McKee M, Nolte E. Lessons from health during the transition from communism. *BMJ*, 2004, 329:1428–1429.
14. McKee M. Alcohol in the Russian Federation. *Alcohol and Alcoholism*, 1999, 34:824–829.
15. *Mortality by 67 causes of death, age and sex (off-line version), supplement to the European health for all database (HFA-MDB)*. Copenhagen, WHO Regional Office for Europe, 2005 (http://www.euro.who.int/hfadb, accessed 28 October 2008).
16. Stephens C, Bullock S. Environmental justice: An issue for the health of the children of Europe and the world. In Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002:190–198 (Environmental Issue Report 29).
17. *The Tallinn Charter: Health Systems for Health and Wealth*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/document/E91438.pdf, accessed 28 October 2008).
18. *Understanding child poverty in south-eastern Europe and the Commonwealth of Independent States*. Florence, UNICEF Innocenti Research Centre, 2006 (Innocenti Social Monitor 2006).
19. Wilkinson R, Marmot M. *Social determinants of health. The solid facts*. Copenhagen, WHO Regional Office for Europe, 2003 (http://www.euro.who.int/document/e81384.pdf, accessed 28 October 2008).
20. Cubbin C, Smith G. Socioeconomic inequalities in injuries: critical issues in design and analysis. *Annual Reviews of Public Health*, 2002, 23:349–375.
21. Cubbin C, Smith G. Socioeconomic inequalities in injuries. *Annual Reviews of Public Health*, 2002, 23:347–375.
22. Zwi A. Injuries, inequalities and health: from policy vacuum to policy action. In Leon D, Walt G, eds. *Poverty, inequality and health*. Oxford, Oxford University Press, 2002:263–282.
23. *Socioeconomic differences in injury risks. A review of findings and a discussion of potential countermeasures*. Copenhagen, WHO Regional Office for Europe (in press).
24. Boland M et al. Urban–rural variation in mortality and hospital admission rates for unintentional injury in Ireland. *Injury Prevention*, 2005;11:38–42.
25. Collins M et al. *At risk. Roma and the displaced in south east Europe*. Bratislava, United Nations Development Programme Regional Bureau for Europe, 2006.
26. *Breaking the cycle of exclusion. Roma children in South East Europe*. Belgrade, UNICEF Serbia, 2007.
27. Runyan CW, Zakocs RC. Epidemiology and prevention of injuries among adolescent workers in the USA. *Annual Review of Public Health*, 2000, 21:247–269.
28. European Environment and Health Information System (ENHIS). *Work injuries in children and young people*. Copenhagen, WHO Regional Office for Europe, 2007 (Fact Sheet No. 4.7).
29. *The prevention of accidents in childhood. Report of a seminar, Spa, Belgium 16–25 July 1958*. Copenhagen, WHO Regional Office for Europe.

30. *World Health Assembly resolution WHA49.25 on prevention of violence: a public health priority*. Geneva, World Health Organization, 1996 (http://policy.who.int/cgi-bin/om_isapi.dll?advquery=WHA49.25andinfobase=whaandrecord={11A0B}andsoftpage=Browse_Frame_Pg42andx=29andy=10andzz=, accessed 28 October 2008).
31. *World Health Assembly resolution WHA50.19 on prevention of violence*. Geneva, World Health Organization, 1997 (http://www.who.int/entity/substance_abuse/en/WHA50.19.pdf, accessed 28 October 2008).
32. *World Health Assembly resolution WHA56.24 on implementing the recommendations of the World report on violence and health*. Geneva, World Health Organization, 2003 (http://policy.who.int/cgi-bin/om_isapi.dll?advquery=WHA56.24andinfobase=whaandrecord={11A09}andsoftpage=Browse_Frame_Pg42andx=32andy=15andzz=, accessed 28 October 2008).
33. *World Health Assembly resolution WHA57.10 on road safety and health*. Geneva, World Health Organization, 2004 (http://policy.who.int/cgi-bin/om_isapi.dll?advquery= WHA57.10andinfobase=whaandrecord={ 11BDA}andsoftpage=Browse_Frame_Pg42andzz=, accessed 28 October 2008).
34. *United Nations Millennium Declaration*. New York, NY, United Nations, 2000b (A/RES/55/2) (http://www.un.org/millennium/declaration/ares552e.htm, accessed 28 October 2008).
35. Children's Environment and Health Action Plan for Europe (CEHAPE) [web site]. Copenhagen, WHO Regional Office for Europe, 2002 (http://www.euro.who.int/childhealthenv/policy/20020724_2, accessed 28 October 2008).
36. *European strategy for children and adolescent health and development*. Copenhagen, WHO Regional Office for Europe, 2005 (http://www.euro.who.int/document/E87710.pdf, accessed 28 October 2008).
37. *WHO Regional Committee for Europe resolution EUR/RC55/R9 on prevention of injuries in the WHO European Region*. Copenhagen, WHO Regional Office for Europe, 2005 (http://www.euro.who.int/eprise/main/WHO/AboutWHO/Governance/resolutions/2005/20050922_1, accessed 28 October 2008).
38. *Consultation of the Member States on elements for a proposal for a Commission Communication and Council recommendation on injury prevention and safety promotion*. Luxembourg: European Commission, 2001 (http://www.eu.int/comm/health/ph_determinants/environment/IPP/ev_20051012_en.htm, accessed 28 October 2008).
39. Bettcher D, Wipfli H. Towards a more sustainable globalization: the role of the public health community. J*ournal of Epidemiology and Community Health*, 2001, 55(9):617–618.
40. Bettcher D, Lee K. Globalization and public health. *Journal of Epidemiology and Community Health*, 2002, 56(1):8–17 (http://jech.bmj.com/cgi/content/full/56/1/8, accessed 28 October 2008).
41. EuroSafe. European Association for Injury protection and Safety Promotion [web site]. Amsterdam, EuroSafe, 2006 (http://www.eurosafe.eu.com/csi/eurosafe2006.nsf/wwwVwContent/l2europeanchildsafetyalliance.htm, accessed 28 October 2008).
42. Pless I, Towner E. Practitioners and policy-makers. In Aynsley-Green A et al., eds. *Unintentional injury in childhood and adolescence*. London, Bailliere Tindall, 1997:393–409.
43. Baker SP, et al (eds). *The injury fact book (2nd edition)*. Lexington, MA: Lexington Books, 1992.

CHAPTER 2
BURDEN OF UNINTENTIONAL INJURIES

2.1 Introduction

This chapter describes the burden and causes of unintentional injuries in children aged 0–19 years in the WHO European Region (Box 2.1).

2.2 Variations in the burden

In 2004, 42 000 Europeans younger than 20 years died from unintentional injuries *(1)*. While injuries are the leading cause of death in those aged 5–19 years, three causes –road traffic, drowning and poisoning – rank among the top 15 causes of death in those aged 0–19 years (Table 2.1). The ranks of different injury types vary with victims' ages. Road traffic injury is the leading cause of death for those aged 5–19, while drowning holds this rank for the group aged 1–4 years (Annex 4, Table 4).

The average age-standardized mortality rate for the group aged 0–19 years in the Region – 18.4 per 100 000 population – masks great variation between countries. When taken together, the rates in LMICs (25.4 per 100 000 population) are more than three times those for HICs (7.9 per 100 000). Comparisons between countries show even greater inequality. Deaths in the countries with the highest rates are almost seven times those in the countries with the lowest rates (Fig. 2.1). Death rates are highest in the Russian Federation, Kazakhstan and the Republic of Moldova and lowest in the Netherlands, Israel and Switzerland. Some countries, such as those in the Caucasus and Balkan region, have less reliable data for the period studied, which are more difficult to interpret *(2)*.

BOX 2.1

Key facts about unintentional injuries in children

- Injuries are the leading cause of death in children aged 5–19 years in the Region.
- There are 42 000 deaths in children aged 0–19 years annually; 5 out of 6 of these occur in LMICs, where death rates are three times higher than in high-income countries (HICs).
- Boys suffer three out of four injury deaths.
- There are a sevenfold difference between countries with the highest and lowest injury death rates, and up to ninefold differences in the variations within countries.
- Injuries cause a huge drain on health resources, with an estimated annual 5 million hospital admissions and 69 million visits to emergency departments in the Region.
- The low injury rates in HICs suggest lives can also be saved in other settings.

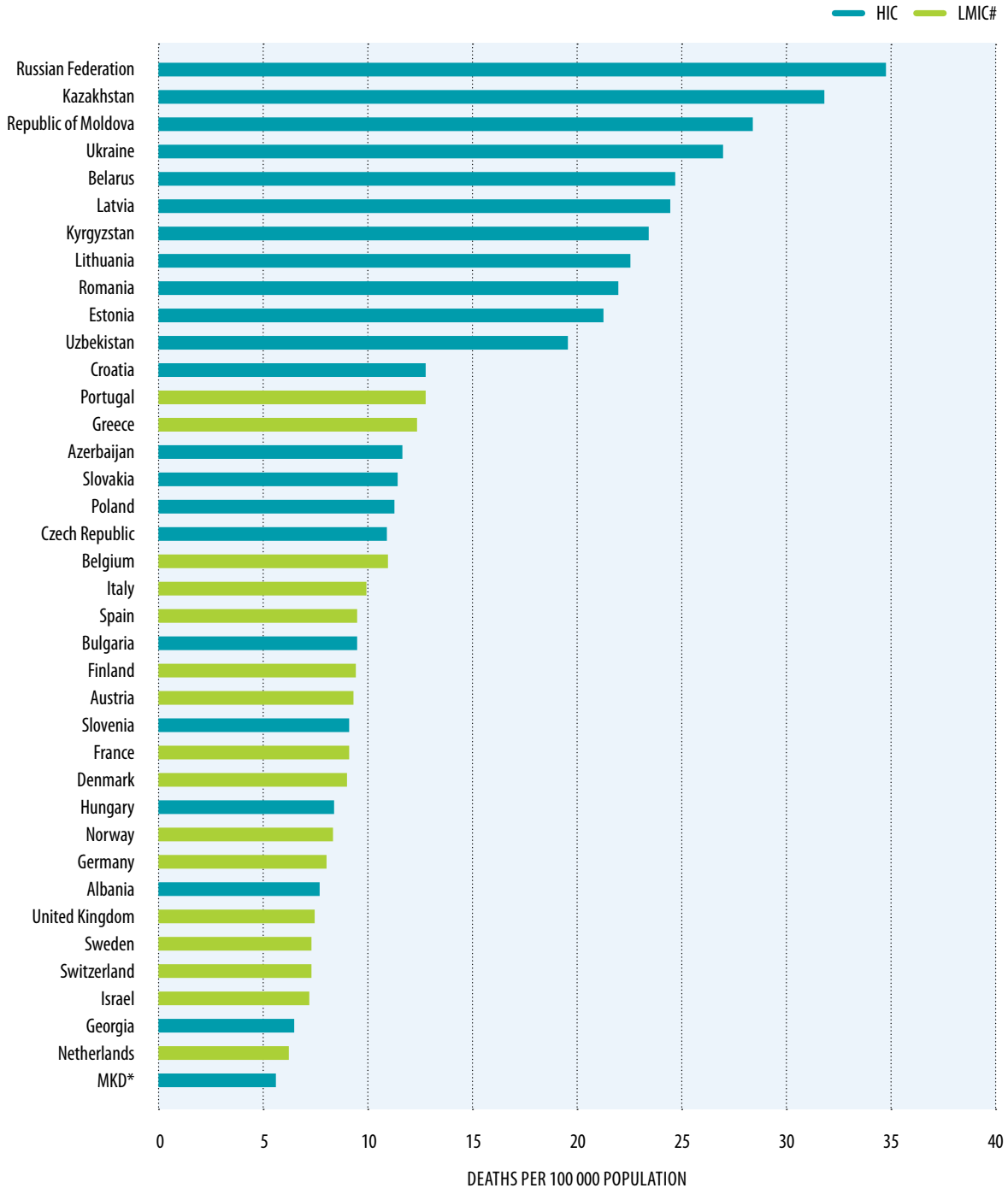
Table 2.1
Ranking of 15 leading causes of death in people aged 0–19 years in the WHO European Region, 2004

Rank	Cause of death
1	Perinatal causes
2	Lower respiratory infections
3	Diarrhoeal diseases
4	Congenital anomalies
5	Road traffic injuries
6	Self-inflicted injuries
7	Meningitis
8	Drowning
9	Leukaemia
10	Violence
11	Upper respiratory infections
12	Poisoning
13	Endocrine disorders
14	HIV/AIDS
15	Epilepsy

Source: The global burden of disease: 2004 update *(1)*.

Figure 2.1

Average standardized mortality rates for all unintentional injuries in children aged 0–19 years in the WHO European Region 2003–2005, or most recent three years

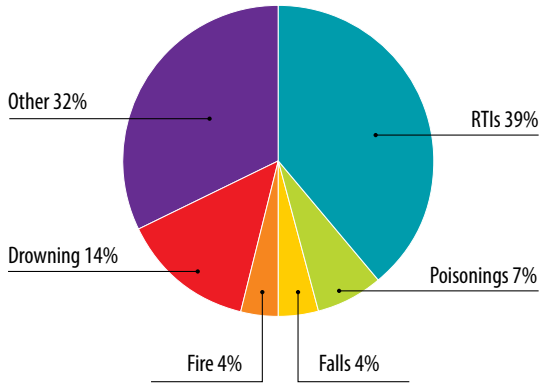


*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Income levels are those defined by the World Bank.
Source: European detailed mortality database *(3)*.

2.3 Leading causes of injury

The leading causes of fatal unintentional injuries were road traffic (39%), drowning (14%), poisoning (7%), fires and falls (4% each) (Fig. 2.2.). Other causes – including deaths from suffocation, choking, strangulation, hypo- and hyperthermia, animal bites, natural disasters, etc. – account for a high proportion of deaths (32%). As the leading causes change with age, those for children aged under 10 years are drowning and road traffic injuries (both 21%), followed by poisoning (8%), while those for older children are RTIs (51%), drowning (9%) and poisoning (7%) (Annex 4, Fig. 6).

Figure 2.2
Proportion of unintentional injury deaths among people aged 0–19 years in the WHO European Region (total deaths: 42 000)

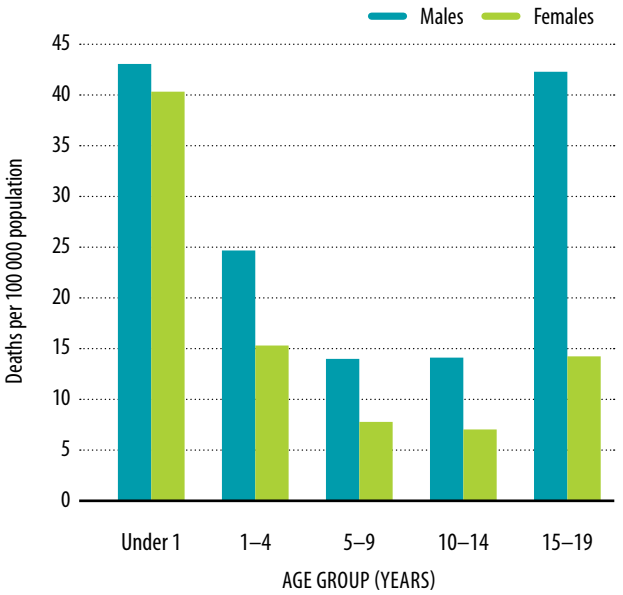


Source: The global burden of disease: 2004 update *(1)*.

2.4 Variations by age and sex

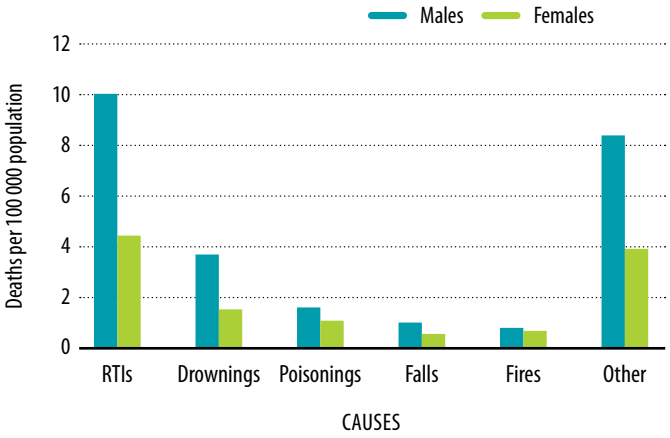
The death rates from unintentional injuries are highest in children under 1 year old (Fig. 2.3), followed by those aged 15–19 years. At all ages, males have higher rates than females, though this difference is minimal for infants and rises sharply in 15–19-year-olds. The explanation for this difference lies more in environmental factors for infants, and in differences in exposures, socialization and risk factors for teenagers. This points to the need for even stronger protective environmental measures to address these factors, especially for infants and older boys. Injury rates are higher in males than females, irrespective of the cause, but the difference in risk of death by gender is greatest for RTIs, drowning and falls and smallest for fires and poisoning (Fig 2.4).

Figure 2.3
Age- and sex-specific death rates for all unintentional child injuries in the WHO European Region



Source: The global burden of disease: 2004 update *(1)*.

Figure 2.4
Unintentional injury death rates per 100 000 people aged 0–19 years by cause and sex in the European Region



Source: The global burden of disease: 2004 update *(1)*.

2.5 Inequalities in the Region by country income

As highlighted in Fig. 2.1, injury mortality in the countries with the highest rates is more than eight times that in those with the lowest rates. In fact, five out of six deaths from injuries in children and teenagers occur in LMICs. Of the 42 000 deaths in the Region in 2004, 7000 were in HICs and 35 000 in LMICs. Comparison of age-standardized death rates for unintentional injuries for the group aged 0–19 as a whole shows that the likelihood of dying from injuries is 3.2 times higher in LMICs than in HICs. Analyses of this difference by age category show that injury rates are highest in those aged 15–19 years in HICs, and in infants in LMICs. The injury death ratios are therefore highest in the younger ages, with ratios for children under 1 year of age over 10 times higher in LMICs than in HICs (Table 2.2). For those aged 15–19, this ratio is 1.7 times higher in LMICs than in HICs.

Table 2.2
Age-specific death rates and death rate ratios for people aged under 20 years in LMICs and HICs

	Age groups (years)					
	<1	1–4	5–9	10–14	15–19	<20
Death rates in:						
HIC	6.49	4.80	2.99	3.86	18.78	7.93
LMIC	66.43	31.82	15.76	13.95	32.71	25.38
Rate ratio:	10.23	6.62	5.27	3.61	1.74	3.20

Source: The global burden of disease: 2004 update *(1)*.

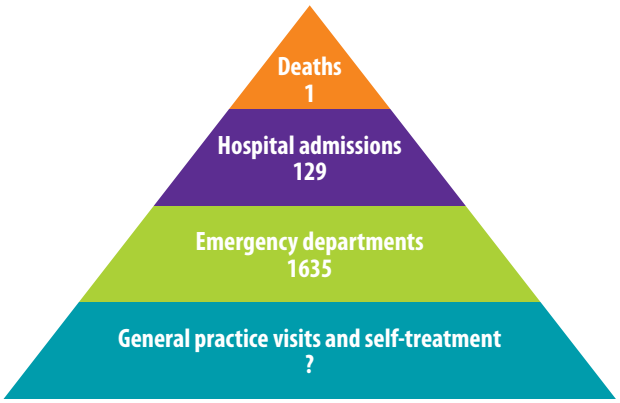
As with other health conditions, childhood deaths from injury show a social gradient *(4)*, irrespective of cause and strongly associated with poverty, single parenthood, low maternal education, low maternal age at birth, poor housing, large family size, and parental alcohol use or drug abuse. Unintentional injuries are the leading cause of inequality in childhood death; this was confirmed by an analysis of Scottish data, and is true for both males and females *(5)*. Data show that the greatest inequalities are in children, rather than other age groups, re-emphasizing their vulnerability to socioeconomic factors. There is a ninefold difference in deaths from unintentional injury in children whose parents are unemployed when compared to those with parents in the highest occupations *(6)*.

These inequalities are both a threat and an opportunity to adapt and transfer good practice and to report experience from countries with lower mortality rates to those with higher rates. The experience of countries that gave priority to injury prevention decades ago, and invested in research, development and practice, represents a most useful resource for the whole Region, and its sharing should be supported as part of international cooperation.

2.6 Beyond fatal injuries

Deaths are only the tip of the clinical iceberg; many non-fatal injuries occur for each death, often with far reaching consequences. Assessing the non-fatal burden remains somewhat challenging, however, given the variety of data systems in the Region. Studies in the Netherlands, Sweden and the United Kingdom were used to create Fig. 2.5. The study in the Netherlands showed that, for every death from home and leisure injuries, there were 160 hospital admissions and 2000 emergency room attendances *(7)*. The United Kingdom study showed a similar ratio: 1 death to 151 admissions and 1947 attendances *(8)*, while for Sweden, the ratio was 1 death to 75 admissions and 959 attendances *(9)*. This gives an average ratio of 1 death to 129 hospital admissions and 1635 emergency room attendances.

Figure 2.5
The clinical pyramid for injuries in children



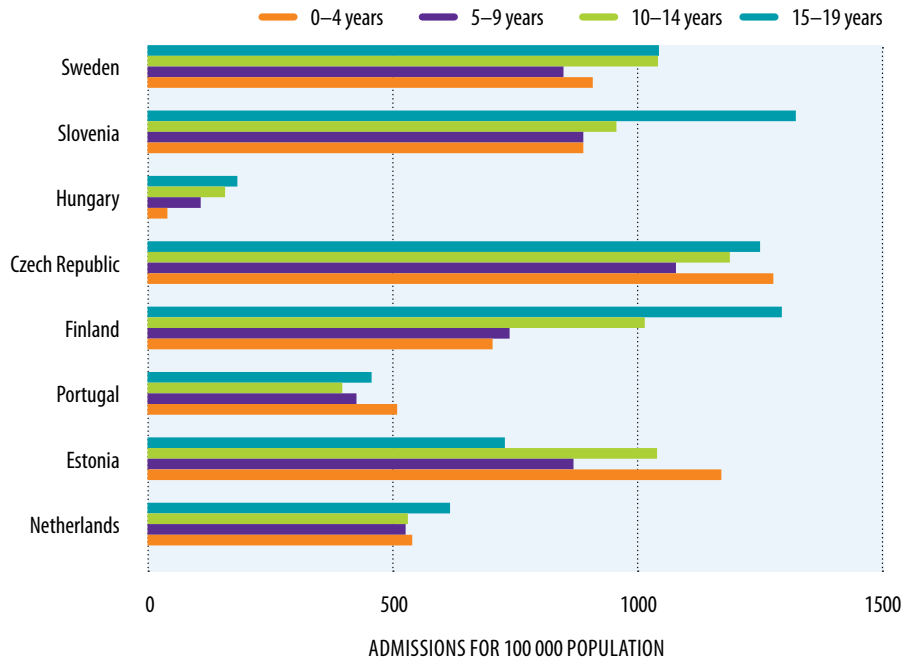
The slope of the pyramid (Fig. 2.5) changes with the proportion of those who die or are seriously injured. This is related to the age of the injured person and the mechanism and severity of the injury. A study from the United States of America estimated that, for every injury death among those under 19 years, there are 45 hospitalizations and 1300 visits to an emergency room *(10)*. Were the ratio for the group aged under 20 in these countries to prevail for the European Region as a whole, in addition to 42 000 deaths, there would be 5.4 million hospital admissions and 68.7 million attendances at emergency departments.

Further, many more millions would seek help from general practitioners or treat themselves. These numbers estimate the prevalence of serious injuries, implying a huge drain on scant health resources, funds not spent treating other conditions and lost productivity. In addition, injuries can have long-term physical and psychological consequences for children, with serious effects on health and well-being in later life for them and their families, whose income prospects can be greatly diminished by the presence of a disabled child requiring long-term assistance. Very little is known about these other important health and economic effects.

Severe injuries in children require hospitalization, which can provide valuable information for prevention. Unfortunately, although most countries have data on hospitalization for injuries, only a few have complete data by mechanism of injury *(11)*. Data from countries for which mechanism information was available in 90% or more of the discharges for that year (Fig. 2.6) show injury admission can vary twofold: for example, the Netherlands versus the Czech Republic. While this may reflect differences in the incidence of severe injuries to some extent, interpreting hospitalization data is complex because of differences in access to hospitals, patterns of health care practice and health care financing. Nevertheless, these data emphasize the frequency of severe injuries in children and confirm the huge drain on health resources. Admission rates appear to increase with age for some countries, and to be highest in children aged under 5 years in a few others.

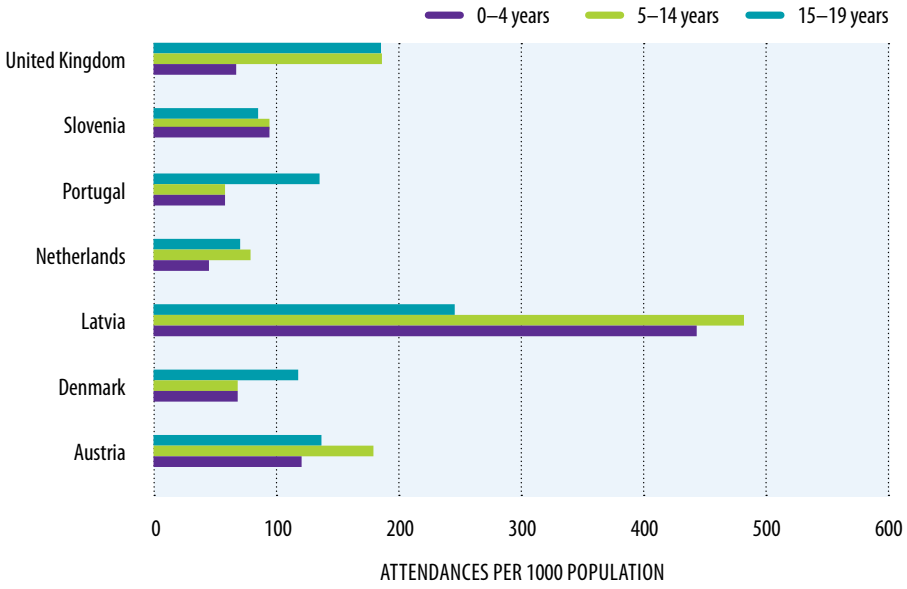
In some countries, data are available on injury-related visits to emergency departments. A study of visits resulting from home and leisure-related injuries in 8 European countries gave attendance rates ranging from 50 and 180 per 1000 population (Fig. 2.7). For most countries, these appear to be lowest in children aged 0–4 years and increase with age; the converse is true in others *(12)*.

Figure 2.6
Hospitalization rates for children with unintentional injuries by age category for selected European countries, 2004



Source: APOLLO Hospital Discharge Database *(11)*.

Figure 2.7
Emergency department attendance rate for home and leisure injuries per 1000 population per year by age for selected European countries, 2000–2004



Source: Adapted from Polinder et al. *(12)*.

2.7 The burden of injuries

As mentioned, injuries can result in lifelong pain and disability. The burden can be quantified with disability-adjusted life-years (DALYs), where 1 DALY is 1 year of life lost to premature death or lived with disability *(1)*. Falls and RTIs rank eighth and ninth among the leading causes of DALYs lost in children aged under 15 years in the WHO European Region (Table 2.3). The actual ranking and the specific types of injuries involved vary somewhat by gender and country income level, with drowning being among the top 15 causes in males in LMICs, and RTIs as the leading injury mechanism in females (Annex 4, Table 6). The often long-term psychological effects of injury on children are difficult to quantify. For RTIs, post-traumatic stress disorder and anxiety can have long-lasting effects *(13)*.

Table 2.3
The 15 leading causes of DALYS among children aged 0–14 years, 2004

Rank	Cause (% of total)
1	Perinatal causes (21.6)
2	Congenital anomalies (9.8)
3	Lower respiratory infections (7.5)
4	Diarrhoeal diseases (7.1)
5	Iodine deficiency (4.0)
6	Unipolar depressive disorders (3.1)
7	Asthma (2.7)
8	Falls (2.2)
9	RTIs (1.9)
10	Refractive errors (1.7)
11	Migraine (1.7)
12	Endocrine disorders (1.5)
13	Schizophrenia (1.4)
14	Meningitis (1.4)
15	Iron-deficiency anaemia (1.3)

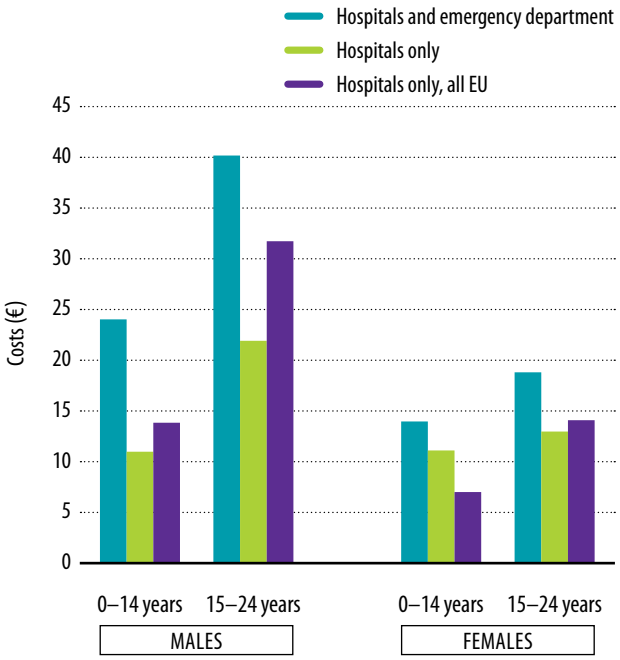
Source: Global burden of disease: update 2004 *(1)*.

2.8 Costs of injuries in children

Injury cost estimates are relatively scarce in the literature, particularly when one examines specific age groups and/or injury mechanisms. Thus, cost estimates are very limited. The most recent European estimates of the average direct medical costs, based on emergency department attendance and hospital admission, are €19 per capita for injuries in children aged 0–14 and €28 per capita for people aged 15–24 years. The costs for injured males are twice those for females, as seen in Fig. 2.8; this reflects both a higher incidence rate and a higher hospitalization rate with more severe injuries. About 60% of these costs are estimated to comprise the direct medical costs of hospitalization, with the rest related to emergency department visits *(12)*. Not only costs but also their distribution between hospital admission or attendance vary by gender and age (Fig. 2.8).

The total societal costs of injuries far exceed the direct health service costs. Injuries have considerable indirect costs, which include those due to lost opportunities, pain and suffering, and wages lost in having to care for injured or disabled children. Few data are available on this.

Figure 2.8
Mean costs per capita in 2005, for total admitted and/or non-admitted injury patients by age category, using aggregated data from Austria, Denmark, Latvia, the Netherlands, Portugal, Slovenia and the United Kingdom (Wales) and an estimate for the EU



Source: Adapted from Polinder et al. *(12)*.

2.9 Conclusions

Unintentional injuries are the leading cause of death in children aged 5–19 years; for each death, there are many more hospital admissions and emergency care visits. LMICs suffer the largest losses: 5 out of 6 of these deaths. The leading causes of death are road traffic, drowning, poisoning, falls and fires. Lessons from HICs suggest that numerous evidence-based interventions exist. This evidence base is an opportunity for action and is discussed in more detail in later chapters. The inequalities highlighted here imply that children in the Region have unequal access to safe environments, and that this inequality is a source of social injustice that needs to be addressed (Box 2.2).

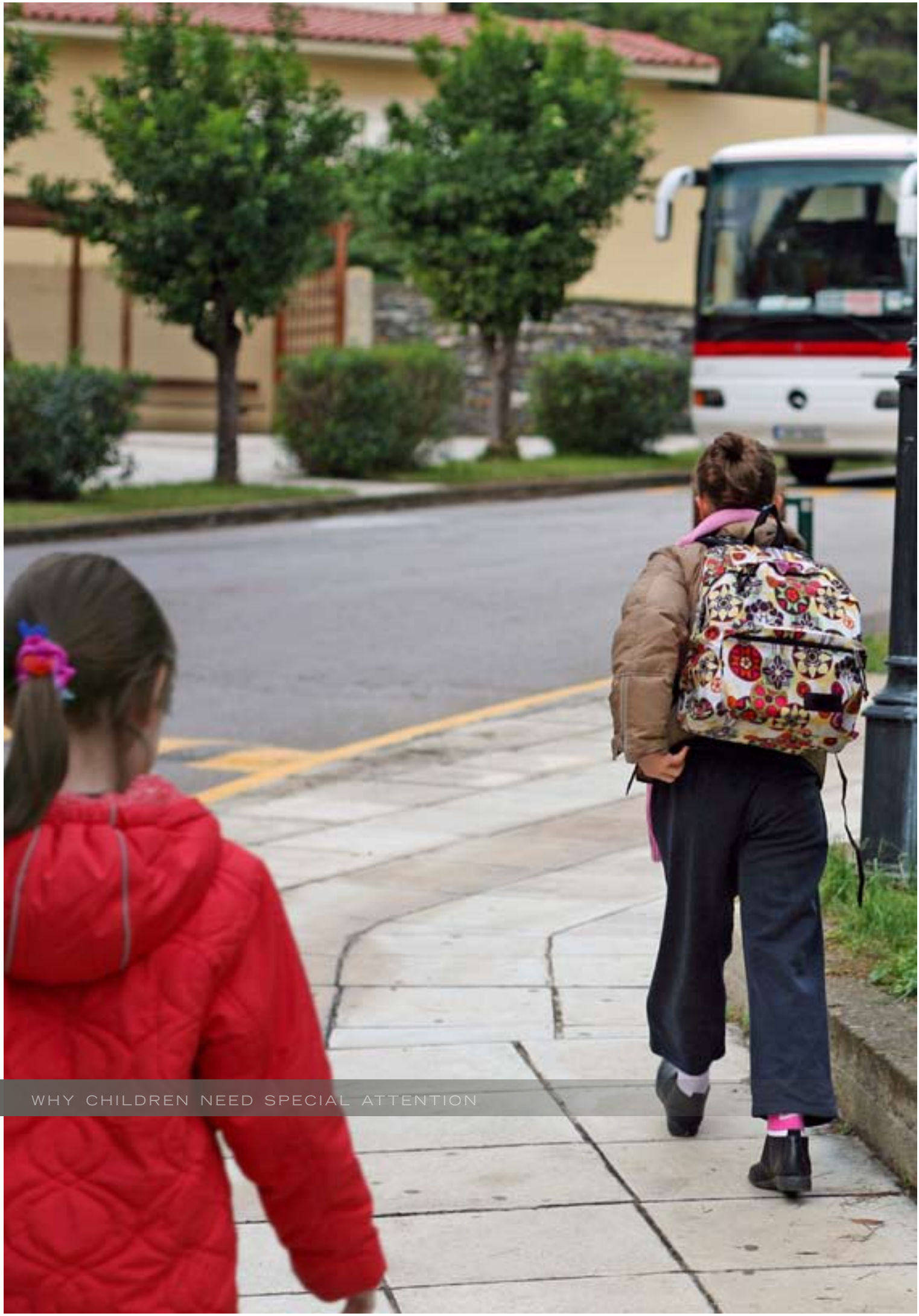
BOX 2.2

Key messages for policy-makers

- Injuries are a leading cause of childhood death and disability, and a huge drain on health and societal resources.
- The Region shows large inequalities between and within countries, implying that children have unequal access to safe environments.
- Better data are needed to understand the consequences and costs of injury.
- Stronger policy support and long-term commitment are urgently needed to address the societal and environmental determinants of injuries and to reduce inequalities.

2.10 References

1. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
2. European health for all database (HFA-DB) [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/hfadb, accessed 10 November 2008).
3. European detailed mortality database (DMDB). Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 10 November 2008).
4. Roberts I, Power C. Does the decline in child mortality vary by social class? A comparison of class specific mortality in 1981 and 1991. *British Medical Journal*, 1996, 313:784–786.
5. Leyland A et al. Cause-specific inequalities in mortality in Scotland: two decades of change. A population-based study. *BMC Public Health*, 2007, 24:172.
6. Edwards P et al. Deaths from injury in children and employment status in family: analysis of trends in class specific rates. *British Medical Journal*, 2006,333:119–122.
7. Rogmans W. Home and leisure accidents in young persons under 25 years of age in the European Union: challenges for tomorrow. *Santé Publique*, 2000, 12:283–298.
8. Walsh S et al. Annual incidence of unintentional injury among 54,000 children. *Injury Prevention*, 1996, 2:16–20.
9. Elkman R, Savnstrom L, Langberg B. Temporal trends, gender and geographical distribution in child and youth injury rates in Sweden. *Injury Prevention*, 2005, 11:29-32.
10. Gallagher S et al. The incidence of injuries among 87,000 Massachusetts children and adolescents: results of the 1980–81 Statewide Childhood Injury Prevention Program Surveillance System. *American Journal of Public Health*, 1984, 74:1340–1347.
11. Segui-Gomez M, et al. APOLLO Hospital Discharge Database. University of Navarra, Navarra, 2008 (http://www.unav.es/ecip/apollo/asistente, accessed 10 November 2008).
12. Polinder S et al. APOLLO: *the economic consequences of injury. Final report*. Amsterdam, EuroSafe, 2008.
13. Rusch MD et al. Psychological adjustment in children after traumatic disfiguring injuries: a 12 month follow up. *Plastic and Reconstructive Surgery*, 2000, 106:1451–1460.



WHY CHILDREN NEED SPECIAL ATTENTION

CHAPTER 3
ROAD TRAFFIC INJURIES

3.1 Introduction

Throughout the European Region, road traffic injuries are a leading cause of death and disability in children (Box 3.1). Children's daily lives include travelling to school, home and play, but this leaves them vulnerable to RTIs in a vast variety of situations. They may be injured as pedestrians while walking to school or playing in the street, as bicyclists enjoying an outing with friends, as motorcyclists while riding to secondary school or as passengers in cars.

BOX 3.1

Key facts on RTIs

- RTIs are the leading mechanism of fatal injuries in the WHO European Region, killing 16 400 children aged 0–19 years per year.
- There is a threefold difference between the countries with the highest and lowest death rates.
- Children living in LMICs have a 60% higher risk of dying from RTIs than those in HICs.
- RTIs are a leading mechanism of traumatic brain and extremity injuries and subsequent long-term impairment.
- Providing safer environments for pedestrians and cyclists will have other beneficial effects, including to promote physical activity and counteracting noncommunicable disease.

This report defines RTIs as fatal or non-fatal injuries resulting from road traffic crashes: collisions or incidents occurring on public roads and involving at least one moving vehicle *(1)*. RTIs remain the leading cause of death among younger Europeans aged 5–19 years, in spite of improvements in traffic safety in many countries (see Annex 4, Table 4).

This chapter augments information in the *World report on child injury prevention (2)* with Europe-specific data, and recommendations relevant to the rich and diverse circumstances in countries.

3.2 Burden in the Region

3.2.1 Mortality

RTIs kill 16 400 children and young people aged under 20 each year in the European Region *(3)*. These deaths comprise 38% of all unintentional injury deaths in this age group (Fig. 2.1), 13% of all RTI deaths for all ages combined in the Region and almost 6% of all child deaths worldwide (262 400) *(2)*. The mortality rates of injury are 10 per 100 000 in males aged 0–19 years and 4.5 per 100 000 in females.

Deaths vary widely in the Region, with an over threefold difference between the country with the highest standardized mortality rate (the Russian Federation, with 10.7 per 100 000) and one of those with the lowest rates and a strong road traffic safety history (Sweden, with 3.3 per 100 000) (Fig. 3.1). Half of the 42 European countries analysed for this report have rates higher than 6 per 100 000. Children living in LMICs in the Region are 1.6 times more likely to die from RTIs than children living in HICs. These differences are highest for infants and lowest for those aged 15–19 years (Table 3.1).

RTIs are the leading cause of unintentional injury death in most of the countries in the Region, but not all. Their share of all deaths ranges from a high of 86% in Italy, to 35% in the Russian Federation, 31% in Romania and 21% in Uzbekistan and Kyrgyzstan (Annex 4 , Fig. 3).

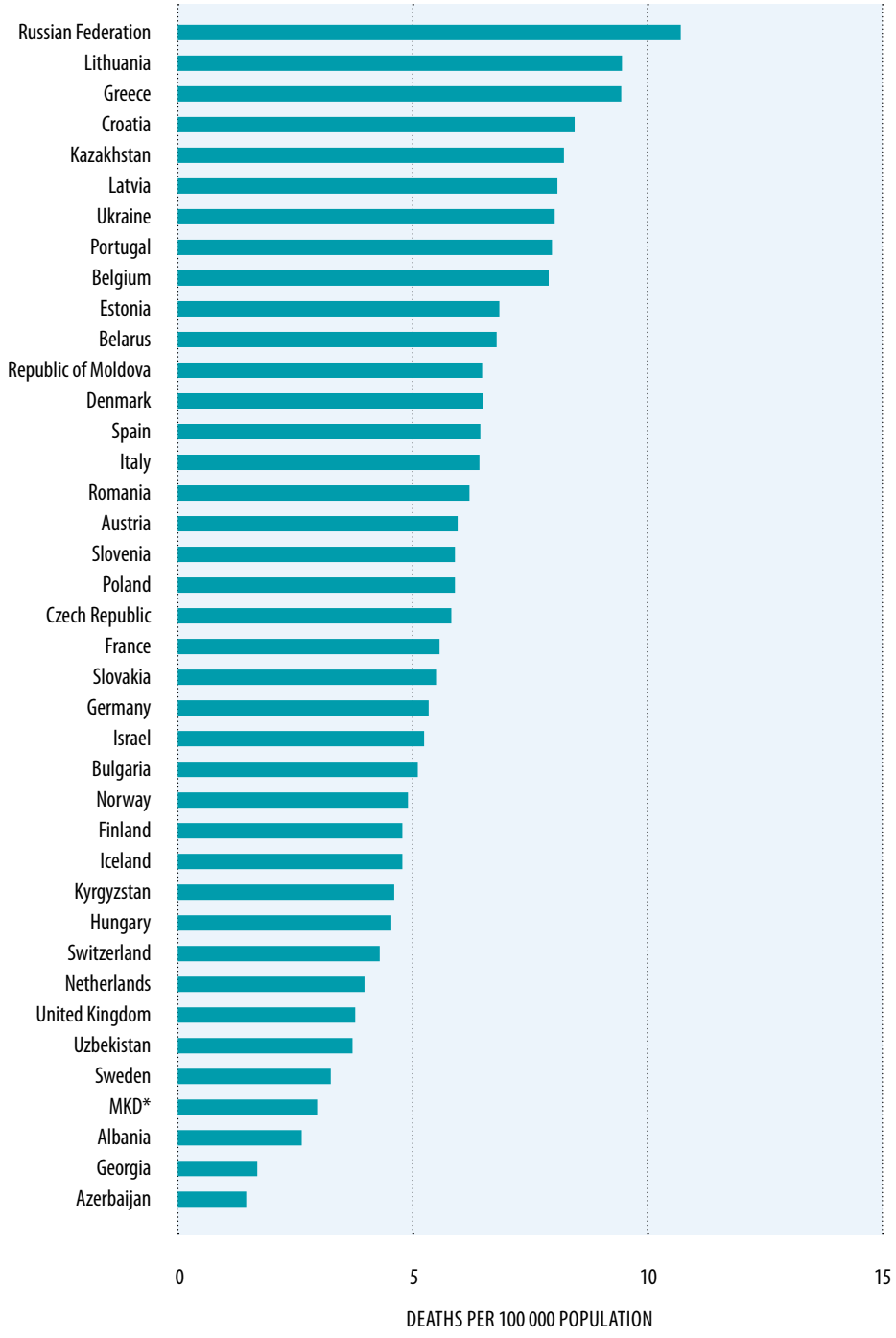
Table 3.1
Age standardized death rates per 100 000 population from RTIs by age group with rate ratios for LMICs versus HICs

	Age groups (years)					
	<1	1–4	5–9	10–14	15–19	<20
Death rates in:						
HIC	1.19	1.30	1.43	2.24	14.75	5.15
LMIC	6.34	4.64	5.49	4.65	15.83	8.30
Rate ratio:	5.34	3.57	3.83	2.07	1.07	1.61

Source: The global burden of disease: 2004 update *(3)*.

Figure 3.1

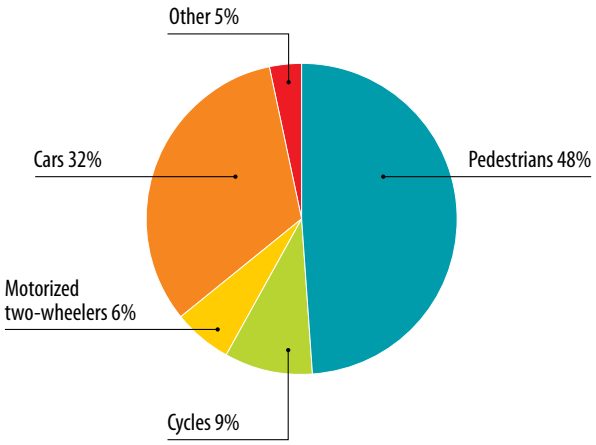
Average standardized mortality rates for transport injuries in children aged 0–19 years in the WHO European Region, 2003–2005 or most recent three years



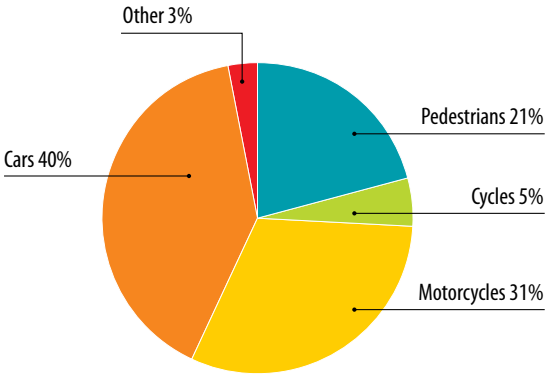
*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: European detailed mortality database *(3)*.

The distribution of road deaths by mode of road user varies with age (Fig. 3.2). Most of the deaths in children aged 0–14 years in the WHO European Region occur to pedestrians (48%), followed by car occupants (32%), cyclists (9%) and motorcyclists (6%) *(5)*. In contrast, young people aged 15–17 are more likely to die in car crashes or on motorized two-wheelers than as pedestrians and bicyclists. This reflects the differences in exposure to risk; older children are more exposed to cars and motorized two-wheelers than walking and cycling.

Figure 3.2
Road deaths by mode of road transport in children aged 0–14 and 15–17 years, averages for 2002–2004 or most recent years



GROUP AGED **0–14 YEARS**



GROUP AGED **15–17 YEARS**

Note. The average annual number of deaths is 4304 in children aged 0–14 and 3565 in those aged 15–17 years.
Source: Handbook of transport statistics in the UNECE region *(6)*.

Analyses of police-reported fatalities in people under age 17 years for 36 countries, by type of road user, indicate that 36% of these deaths occur to occupants of passenger vehicles, 35% to pedestrians, 18% to drivers and riders of motorized two-wheelers (mopeds and motorcycles), 4% to cyclists and the remaining 7% as other road user types, including lorries, trucks and public transportation. The exact distribution changes by country, as shown in Fig. 3.3, with pedestrians representing as much as 72% of the total in Kyrgyzstan and as little as 13% in Denmark, while motorized two-wheelers accounted for 33% of victims in France and cyclists up to 30% in the Netherlands *(7)*.

3.2.2 Sociopolitical and economic change in the Region

The change to market economies in eastern Europe and the CIS accompanied an unprecedented increase in motorization in many countries *(8–10)*. Changes in infrastructure, safety standards, laws and regulations, however, have not kept pace *(11–13)*. Increased levels of alcohol intake, another RTI risk factor, plus heavy marketing by the alcohol industry, has meant more drink–driving. Coupled with this are insufficient capacity of road safety experts and changes in governance that have led to inadequate enforcement of safety standards and laws *(14)*. Trends show an increase in RTIs in children in the early 1990s with a second peak in the mid-2000s. For example, the transition to a market economy in Lithuania resulted in peaks during the periods of greatest change. Although downward trends followed, Lithuania's RTI rates are still among the highest in the Region, and deaths from road traffic crashes have not shown significant declines, in contrast to other causes of child mortality *(15)*.

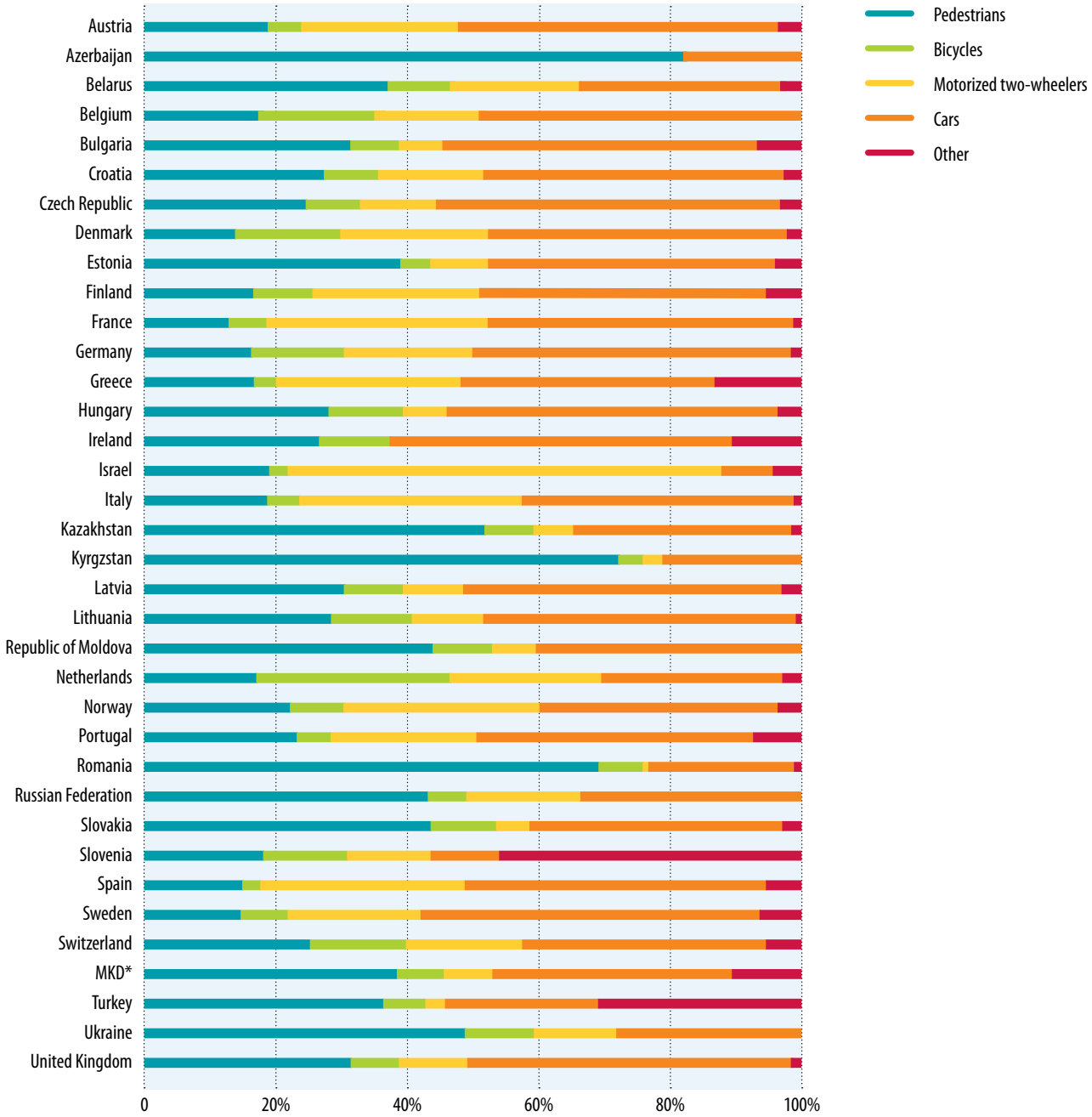
3.2.3 Changing patterns of transport and exposure

Even the EU has seen a 37% increase in cars on the roads, from 160 million in 1990 to 220 million in the 25 Member States in 2005. This is equivalent to 476 passenger cars per 1000 inhabitants. In contrast, the number of buses rose by only an estimated 6%, suggesting greater reliance on private cars for transport *(16)*.

Trend data show falling child RTI mortality in the EU, with much of this decrease due to reduced exposure as pedestrians and bicyclists. In other words, rates have been reduced mostly at the expense of moving children off the pavement and bicycle and into private cars or on motorized two-wheelers. Studies have documented this shift; for example, one on child road use in England and Wales between 1985 and 1995 found that the average distances walked and cycled each year by children under 14 fell by 20% and 26%, respectively *(17)*. Factors underlying this shift include the much wider availability of cars, an increase in parental choice in education (leading to longer journeys to school), the increased pace of family life (with more activities in limited time) and the exaggerated fear of strangers by children out alone *(18)*. Further, the net good of some of

Figure 3.3

Proportion of deaths by mode of road transport among children aged 0–17 years in selected European countries, average for 2002–2004 or most recent three years



Source: UNECE transport database *(7)*.

the reductions may be questionable, as they do not take account of the negative effects on exercise (and its impact on obesity), pollution (and its asthma-related consequences), changes in urban planning or climate change.

Thus, the shift in transportation modes may not be the most efficient way to meet the population's health and transportation needs, in view of the growing epidemic of obesity, or the best example for countries and regions that have fewer resources and are on the cusp of motorization *(9,19)*. Further, the shift in transport modes may confound commonly performed comparisons of rates between countries *(20)*.

3.2.4 Socioeconomic determinants

Children of lower socioeconomic class are at much greater risk of RTIs than the more advantaged. Reducing this risk is particularly important because socioeconomic inequality is increasing in many countries in the Region *(10,21,22)*. Studies from the United Kingdom showed that, among children aged 0–15 years, those in the lowest socioeconomic class were four times more likely to die from RTIs and five times more likely to die as pedestrians than those in the highest class *(23)*. A more recent study showed that children of unemployed parents were 5.5 times more likely to die as car occupants, but more than 20 times more likely to die as pedestrians or bicyclists as those in the highest social class *(22)*. Socially disadvantaged children are more likely to live in neighbourhoods with unsafe roads, high-speed traffic and few safe areas to play; their families find safety equipment less affordable and have less access to high-quality emergency trauma services *(24)*.

Children of families in higher socioeconomic groups disproportionately reap the benefits of safer environments, behaviour and vehicles, and access to safety equipment. In fact, a study in Scotland suggests that unintentional injuries (and road traffic is the leading injury mechanism) are the largest contributors to inequalities in childhood *(25)*. In the United Kingdom, where one can get a driver's licence at 17, young drivers from deprived backgrounds are more likely to have driven without a licence, and to drive recklessly and without wearing a seat-belt *(26, 27)*.

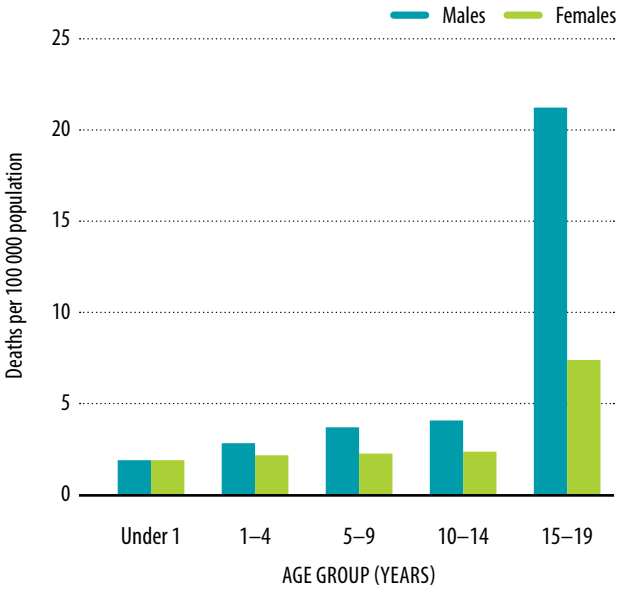
3.2.5 Gender

The shift in transport mode affects gender-based injury and death rates. In the European Region, these differences are somewhat larger than those described in the *World report on child injury prevention*, and this probably reflects European males' greater uptake of motorized two-wheelers and cars *(2)*.

As seen in Fig. 3.4, the largest difference in female-to-male death ratios is 1:3 and arises in the group aged 15–19 years. Although the requirements vary from country to country, the minimum age for riding a motorized two-wheeler is 14 years in France, Spain and Switzerland, but 15 or 16 in other countries *(28)*. Although Region-wide figures on motorcycle licences are elusive, there are 2.5 boys with licences for every girl among those aged 14–17 years in Spain; this ratio rises to 5:1 if only moped licences are considered *(29)*. Unsurprisingly, the female:male ratio in motorcycle fatalities among those aged 15–24 years is 1:14.5, while the corresponding average ratio in 18 selected EU countries is 1:9 *(29)*.

Figure 3.4

Age- and gender-specific mortality rates for RTIs in children in the WHO European Region, 2003–2005 or last available three years



Source: The global burden of disease: 2004 update *(3)*.

3.2.6 Morbidity

Measuring the non-fatal burden of RTIs in children is more difficult, mostly as a consequence of less developed information systems. According to some country-specific studies, for every person who dies, 20 more require hospital admission for serious injuries, 70 attend an emergency department and many are seriously disabled *(30,31)*. Health service and vital registration data may be more complete than police data, since police reports have been proved to underestimate non-fatal and fatal injuries (by 40% and 3–7%, respectively) *(30,32)*. The data from police, emergency departments and hospitals need to be linked to develop more comprehensive surveillance systems. In some countries, underreporting is considerable, and correcting this is a priority to improve understanding of the scale of the RTI problem in children in the Region.

Children's injuries in road traffic crashes vary considerably in type and severity. Table 3.2 shows data on 1304 children aged less than 12 years discharged from hospitals in 10 countries due to injuries as car occupants in 2004. The most common type was traumatic brain injury, followed by fractures of the limbs and injuries to organs in the abdomen and chest. A large proportion of children suffered from multiple trauma, which is associated with higher death rates. The high severity of injuries to children in road traffic crashes *(33)* underlines the need for high-quality paediatric trauma care. In some countries, only 10% of such hospitalized cases were completely coded to show the cause of injuries.

Table 3.2
RTIs to 1304 children younger than 12 years, discharged from hospitals in 10 European countries, 2004

Site	Type									Total (%)
	Fracture	Dislocation	Internal	Open wound	Amputations	Blood vessels	Contusion/ Superficial	Crush	Burns	
Traumatic brain injury	124	0	531	142	0	0	0	99	0	896 (43)
Other head	72	10	0	71	26	1	156	0	0	336 (16)
Neck	0	0	0	0	1	0	13	0	0	14 (1)
Neck and head other	0	0	0	0	0	0	44	0	1	45 (2)
Spinal cord	3	0	0	0	0	0	0	0	0	3 (0)
Vertebral column	16	1	0	0	0	0	0	0	0	17 (1)
Thorax	14	0	18	1	9	1	57	0	0	100 (5)
Abdomen, pelvis, trunk and lower back	20	1	73	6	22	1	114	0	0	237 (11)
Upper extremity	143	2	0	28	4	0	28	1	1	207 (10)
Lower extremity	134	1	0	25	9	0	47	1	1	218 (10)
Hip	17	3	0	0	4	0	3	0	0	27 (1)
TOTAL	543	18	622	273	75	3	462	101	3	2100 (100)

Source: Lopez-Valdes et al. *(33)*.

Studies using emergency-based data are scarce in Europe. A study in the Lazio region, Italy, found incidence rates of 1000, 1500, 3000 and 7200 injuries per 100 000 boys aged 1–4, 5–9, 10–14 and 15–19 years, respectively. Incidence for girls also increases with age, but, unlike the threefold difference in fatality rates, the female-to-male ratios increase from one at 1–4 years to 1.7 in 15–19-year-olds, suggesting that adolescent girls are less likely than boys to be fatally injured in a car crash *(34)*. A study in Romania indicates that the most common injuries in paediatric RTI victims seen in the emergency department are to the head and upper and lower extremities *(35)*.

More data are needed on the longer-term consequences of RTIs to children. The lack of data is related to both the lack of sufficiently appropriate measurement scales and the absence of long-term follow-up studies. WHO estimates that RTIs account for 2% of all DALYs lost in children younger than 15 years, and rank ninth among causes in the Region (Table 2.3).

3.2.7 Psychological and social effects

Many children develop post-traumatic stress disorder and anxiety after a road traffic crash. These are common and may be short lived, although reports suggest that they may still be present 12 months later in a about a third of children, with flashbacks, fears of being injured again, sleep disturbances and anxiety *(36)*. Psychological upset is likely to be worse if a relative is also injured in the crash and if the injuries lead to loss of work and family position.

3.2.8 Costs

Although the literature includes a number of cost estimates for RTIs *(1,37)*, none is specific to child victims or derived from representative European data *(38,39)*. Thus, additional work needs to be done to identify direct medical and non-medical costs, as well as indirect costs related to both the possible present or future productivity losses from injured children and the impact of the care given them by family members.

3.3 Risk factors for RTIs

Several risk factors for RTIs in children have been identified *(2)*. Children are vulnerable road users, owing to not only their particular circumstances but also the actions of adult road users in unsafe environments. Some risk factors are related to children's developmental characteristics. For example, their small stature makes them more susceptible to injuries in both number and severity for a given amount of mechanical energy. Their cognitive development limits their capacity to evaluate risks. These factors become less important as children mature, and are superseded by risk-taking behaviour and peer influence in adolescents.

The environment and vehicles with which children interact as pedestrians and bicyclists are critical. Societal norms for transportation play a strong role. The provision of sufficient safe and efficient public transportation systems reduces the volume of private vehicles on the road. Street and road design influence risk. In particular, the provision of safe areas to play and walk and roadside barriers to

separate cars from children, and the use of road designs forcing lower travel speeds or of raised pedestrian crossings are protective factors.

Controlling vehicle speed is the most important factor in preventing serious injury to child pedestrians and cyclists, as the risk of fatal injury increases exponentially with speed *(9)*. Having safer vehicle bumpers and front ends can also markedly reduce harm by reducing damage to the lower and upper legs and heads of children and adults in the event of a collision. The differential tolerance of children to mechanical force resulting in injury deserves further attention, since knowledge is limited and European regulations need to be better informed by scientific knowledge *(40)*.

Failure to use seat-belts and child restraints is a major hazard, and is more likely to occur after alcohol use in adolescents and adults *(41,42)*. Seat-belts and child restraints are essential for improving the safety of car occupants, reducing injury by 45–55% and 60–95%, respectively *(43)*. Car manufacturers have only recently started incorporating the aim of protecting children (as passengers and pedestrians) in vehicle design. Issues include ensuring that child safety seats are compatible with vehicle interiors and dealing with the differences in safety seats and their placement to protect children as they grow; the latter is such a complex task that many children ride inadequately protected *(44)*. Box 3.2 highlights the effect of alcohol on road injuries.

Wearing helmets reduces the risk of serious injury and death from motorcycle and bicycle crashes. Wearing a motorcycle helmet reduces the risk and severity of head injuries by about 72% and the likelihood of death by up to 39%. The evidence for bicycle helmets shows a reduction of 63–88% in head and brain injury *(45-47)*. Adolescents in many countries question the efficacy of helmets, however, and peer pressure reinforces their unacceptability *(43)*.

Poor conspicuity – the inability easily to distinguish and notice road users – makes children more susceptible to being hit by vehicles. This is true for pedestrians, bicyclists and motorcyclists, and particularly at night. In countries such as Estonia and Finland, over half the crashes involving vulnerable road users happen at night.

Given the inequalities in injury rates between and within countries, the availability and affordability of safety equipment are important factors in ensuring children's safety. A study examining this issue in 18 countries in the European Economic Area found that availability was lower in newer EU Member States. Expressed in terms of hours of work for factory workers using local wage rates, the relative prices of bicycle helmets and child restraints were 3–4 times higher and up to 6.5 times higher, respectively, in such countries as the Czech Republic or Hungary than in countries such as Germany and the United Kingdom. Affordability is likely to be even lower in central and eastern countries in the WHO European Region, as illustrated by an earlier global study that found relative prices for cycle helmets and car child restraints to be 20 times higher and 11 times higher, respectively, in Albania than a HIC such as the United Kingdom. Market forces influence intercountry differentials in price and availability; subsidies are needed to keep costs down and retailers need to price equipment more competitively *(48,49)*.

Last, timely and age-appropriate medical care and rehabilitation services are essential to reducing the burden of RTIs.

BOX 3.2

Binge drinking and RTIs in teenagers in Spain

Two minors died early one morning in a road traffic accident in Sarria (Lugo), Spain. The victims were two 15-year-old girls who were in the rear seats and not wearing seat-belts. Another three young people aged 16–18 sustained severe injuries; one was admitted to the intensive care unit of a nearby hospital with severe cranial trauma, as well as pelvis and femur fractures. The 19-year-old male driver was the only uninjured occupant and tested positive for alcohol. The six young people in the car were returning from a *botellón* ("big bottle") in Sarria, which had been organized by high school students from the city.

A *botellón* involves the gathering of a large number of young people aged 16–24, usually in open spaces, to drink alcoholic beverages bought in shops (usually supermarkets), listen to music and talk. Teenagers often organize these events because of the high prices in bars and being too young to enter bars and clubs. Typically, 1 bottle of alcohol (0.75 litres whisky, rum, vodka, etc.) is consumed per 2–4 people, mixed with ice and a soft drink. The drinks are consumed from shared bottles or one-litre plastic glasses.

Drinking on the street has always been permitted in Spain, but the *botellón* phenomenon appeared in the 1990s and has grown gradually since then. The gathering usually lasts 2–4 hours and is the first thing that many young people do each weekend. In some cities, parties attract over 3000 people every Saturday night, but they can be as big as 70 000 people.

Botellón generates problems besides RTIs: noise, dirt, economic losses to legal businesses, other health consequences and legal issues. While the legal age for buying alcohol in Spain is 18 years, minors are allowed to drink if an adult made the purchase.

Other European countries where binge drinking occurs are the Czech Republic, Germany, the Russian Federation and the United Kingdom.

Source: Information from Ojea A. Four adolescents die in two car crashes in Lugo and Hueva. The driver of the vehicle that crashed in Galicia who was returning from a "botellón" had a positive alcohol test and was not injured. DIARIA SUR, Malaga, Diario Sur Digital, SL. 1 October 2007 (http://www.diariosur.es/20071001/espana/fallecen-cuatro-adolescentes-accidentes-20071001.html, accessed 10 November 2008).

3.4 What can be done

Several authoritative international reports specifically recommend interventions to reduce motor vehicle injuries *(1,50)*. Table 3.3 reproduces the latest WHO recommendations *(2)*, which this report fully endorses and describes in more detail below. In addition, social responsibility and community awareness should be promoted and road design and speed control improved.

3.4.1 Societal responsibility

Countries in the European Region with lower rates of RTIs have "invested in safety as a societal responsibility", rather than delegating this duty to individuals or organizations *(5)*.

One way to address this societal responsibility is to limit exposure to motorized traffic while encouraging walking and cycling, the use of mass transport and safe routes to and from it: in other words, making walking a healthy and safe transportation mode. Reports from the European Region have shown that only one third of children aged 11–15 years are sufficiently physically active *(51)*. Countries such as Denmark and the Netherlands have actively developed policies and infrastructure that encourage cycling and walking *(5)*, which both decrease reliance on private cars and promote alternative, healthier transportation modes (Box 3.3).

Table 3.3
Key strategies to prevent RTIs among children

Strategy	Effective	Promising	Insufficient evidence	Ineffective	Harmful
Zero-tolerance alcohol laws	✖				
Laws on minimum legal drinking age	✖				
Lower blood alcohol concentration levels	✖				
Mass-media publicity	✖				
Child safety seats	✖				
Booster seats	✖				
Seat-belts	✖				
Motorcycle helmets	✖				
Bicycle helmets	✖				
Graduated driver licensing systems[a]	✖				
Rear seating position	✖				
Education-only programmes for child-seat use			✖		
Designated-driver programmes			✖		
Increasing visibility of vulnerable road users			✖		
School-based instruction programmes for drinking and driving			✖		
School-based driver education[a]				✖	
Airbags and children					✖
Early licensure for novice teenage drivers[a]					✖

[a] Graduated driver licensing systems, school-based driver education and early licensure for novice teenage drivers are less relevant in the European context, since driver's licences are granted to 18-year-olds in most countries.
Source: Peden et al. *(2)*.

BOX 3.3

Safe transportation and promoting physical activity

The National Institute for Health and Clinical Excellence in the United Kingdom has produced evidence-based guidance on promoting and creating built or natural environments that encourage and support physical activity *(52)*. This links wider concerns about physical activity and obesity with road-safety initiatives, ensuring that users of modes of transport that involve physical activity (pedestrians and cyclists) are given the highest priority when streets and roads are developed or maintained. This can be done by:

- reallocating road space to support physically active modes of transport (for example, by widening pavements and introducing cycle lanes);
- restricting motor vehicle access (for example, by closing or narrowing roads to reduce capacity); and
- introducing road-user charging schemes.

3.4.2 Community awareness

Some qualitative studies indicate the importance of community involvement in taking measures to improve safety. For example, adolescents in Barcelona, Spain, are aware of the threat of RTIs and admit that fines, speed-control measures and breath testing for alcohol are effective countermeasures. Nevertheless, they prefer community service to fines, demand information on politicians' decisions on regulations and request increases in public transportation, particularly at night and weekends *(53)*. In the United Kingdom, interviews showed that parents of children aged 9–14 widely appreciate local hazards and support more enforcement and the creation of better pedestrian facilities and safe play areas *(20)*. Boxes 3.4 and 3.5 give examples of community involvement in safety improvements.

BOX 3.4

The "Streets Ahead on Safety" project, Birmingham, United Kingdom

Birmingham City Council's "Streets Ahead on Safety" project aims to improve road safety and the quality of life in the inner city. Alum Rock is a deprived area in Birmingham, inhabited by people from largely Asian immigrant backgrounds. The area has a poor record of RTIs in children.

This project encouraged a highway authority, engineers and road safety officers to provide local young people with opportunities to participate in decision-making on issues relating to their safe use of the roads and engineering plans for their local community.

Children questioning road safety engineers on road safety plans in a school

A photograph showing hazards in a road near a school, taken by children conducting a safety audit

The project included 405 young people aged 9–11 years in 5 schools, who conducted environmental audits in the areas near their schools, taking photographs of hazards to pedestrians. Other elements included interactive training in road-safety awareness and citizenship. Road-safety engineers made a video of specific plans for the areas immediately outside schools and the children were able to study maps of the plans. Highway engineers visited the schools, where pupils questioned them on their plans. The children then voted for the plan they thought would be best for their area. Young people were thus encouraged to be stakeholders in their own safety and actively to engage with highway engineers and road-safety officers in developing engineering proposals.

Source: Kimberlee *(54)*.

BOX 3.5

"Salman and Friends" – involving the local community in developing resources, Blackburn, United Kingdom

"Salman and Friends" offers resources on road safety, designed for children under 5 and created by a group of parents from Blackburn in north-western England, working in partnership with play development workers, the local road safety department and the Neighbourhood Road Safety Initiative funded by the Department for Transport. Blackburn has high levels of social deprivation and child pedestrian injuries.

The resource pack is aimed at parents/carers, who read the stories at home to their children, but any early years' teacher can incorporate it into school sessions. A small group of parents developed the content and format of the books. After an initial ideas session on road-safety issues for this age group, the parents' personal experiences and practical tips were developed into stories.

The pack consists of four storybooks, each conveying a simple but important road-safety message for children to learn and practise as pedestrians when out with their parents or carers. The first book emphasizes the importance of holding hands with a grown-up when out and about, and introduces the concept of the mosque as a setting, as opposed to school. Useful suggestions for parents, carers and teachers and follow-up activities to reinforce each message are given at the back of each book. The books are accompanied by an audio CD containing songs; these are available in English, Urdu, Hindi, Bangla, Punjabi and Gujarati.

Source: Salman and Friends [web site] *(55)*.

3.4.3 Improving road design

Safer road design protects a variety of road users, including the most vulnerable. Area-wide traffic-calming measures have been shown to reduce the number of RTIs by 15% *(56)*. Changes in road design are cost-effective. Estimates based on Norwegian figures show that a variety of road improvements are of proven benefit and that every euro spent on an intervention leads to savings on health care. Table 3.4 shows examples of possible savings *(57)*.

Table 3.4
Possible savings in health care costs from improving road design

Spending of €1 on road design measures	Savings (€)
Simple road markings	1.50
Upgrading marked pedestrian crossings	14.00
Pedestrian bridges or underpasses	2.50
Guard rails along the road side	10.40

Source: data from Cost effective EU transport safety measures *(57)*.

3.4.5 Speed

Setting and enforcing speed limits, regulating traffic and making the overall speed more consistent have been shown to help prevent crashes involving pedestrians and cyclists (43). In determining speed limits, consideration needs to be given to road function, traffic composition, types of road user and road design. In this respect, controlling the speed and volume of traffic in urban areas and separating traffic from vulnerable road users are critical factors. This can be achieved by setting and enforcing speed limits of less than 30 kph in heavy pedestrian areas *(58)*, reducing traffic volume, using physical traffic-calming measures such as speed bumps or building cycle lanes and pedestrian walkways.

Concern has been expressed in many countries about reducing mortality and disability in pedestrians and cyclists *(59,60)*. Local knowledge and action are needed to develop measures for traffic calming and volume reduction around schools and residential areas, especially in low-income neighbourhoods.

3.4.5 Alcohol

Most EU countries have an upper limit of blood alcohol concentration of 0.05 g/dl or less, with exceptions at 0.08 mg/dl: Malta and the United Kingdom *(61)*. Most countries in the CIS have a limit of zero *(14)*. This limit is recommended for drivers under 21 years *(62)*. High-visibility random breath testing, as part of enforcement, is highly cost-effective in discouraging drink–driving: estimates suggest that every euro spent on this would save €36 *(57)*.

Tolerance limits vary in practice, however, with some countries reporting poor enforcement and penalties too light to act as deterrents *(14)*. Variation is also found in the visibility of public awareness campaigns, police jurisdiction to undertake testing without due cause and controlling of sales of alcohol to young people.

3.4.6 Child car restraints, seat-belts and seating position

Cost–effectiveness studies show that every euro spent on child restraints saves €32 in health care spending *(63)*. The use of seat-belts and child seats has been widely proven to lead to economic savings *(64,65)*, and it can be maximized through legislation and enforcement, accompanied by educational campaigns. Legislation, parental knowledge, availability, cost and accessibility influence the use of child restraints. Community-based approaches – consisting of educational initiatives and loan schemes or subsidization – ensure the inclusion of lower-income families. Proper use of restraints according to children's height or age may be a problem even in countries with high usage, and appropriate instruction is required.

Legislation in the 1980s and early 1990s in Europe promoted placing children in vehicles' rear seats. Although most recent regulations only emphasize the need for appropriate restraint, until recently children in Europe were more likely than those in other developed countries to be placed so *(66)*. Many studies, although none specific to Europe, assess the improved safety of rear-seat placement, even when children and adolescents are appropriately restrained, and this is particularly true for vehicles equipped with airbags for front-seat passengers *(44)*.

3.4.7 Helmets

While wearing a helmet when riding a motorcycle is a legal requirement in many countries, enforcement is required to increase rates of use and supplementing enforcement by educational campaigns leads to further gains. Helmet distribution programmes, to help meet the costs for schoolchildren from lower-income households, have been shown to increase uptake among those difficult to reach.

Cycle helmets are of proven efficacy in reducing head injury *(67)*. Estimates show that each euro spent on cycle helmets leads to a saving €29 in health care spending *(63)*. A range of measures in different contexts is used to promote cycle-helmet use, including both non-legislative and legislative approaches. Among the former, community-based approaches including the free provision of helmets and an educational component are somewhat more efficacious than school-based education and subsidized helmets for schoolchildren *(68)*. Legislation, especially in conjunction with information campaigns, has been shown to be effective in increasing helmet use *(67)*.

3.4.8 Conspicuity

Specific measures to increase conspicuity improve detection by drivers *(69)*. For pedestrians, measures include people's wearing reflective strips or light clothing and walking facing oncoming traffic. Cyclists can wear reflective clothing and use bicycle lamps, and front, rear and wheel reflectors. Motorcycle riders can use daytime running lights, and wear reflective clothing and white or light-coloured helmets.

Improving street lighting benefits all vulnerable road users; urban and road planners should improve lighting, particularly in areas of high traffic and population density. Every euro spent on road lighting is estimated to save €10.70 in health care spending *(57)*. Motor vehicles' using running lights in daytime eases detection by other road users, with a 15% and 10% reduction, respectively, in pedestrians and cyclists hit by cars after introduction of the measure *(38)*.

3.5 Conclusions

Children need special consideration as vulnerable and inexperienced road users. A failure to safeguard the roads compromises their fundamental right to safety. The European Region shows large disparities in deaths from RTIs, with a threefold difference between the countries with the highest and lowest rates. Inequalities in RTIs by socioeconomic class within countries are a growing concern. The inequalities in the Region reflect important differences in exposure to risk, environmental risk factors and enforcement practices. Such inequities in health should be addressed as a matter of social justice.

In the WHO European Region, RTIs are the leading cause of death and disability in children and adolescents, and have significant and substantial non-fatal and long-term consequences. The challenge to reduce the inequalities is also an opportunity to tackle the problem as a societal responsibility and by introducing structural community-based interventions that will provide efficient solutions to all, regardless of class (Box 3.6).

BOX 3.6

Key policy messages

- RTIs are a leading cause of death in children in the Region, and large variations exist both between and within countries, largely related to socioeconomic status.
- Unsafe road design, speed, excessive alcohol intake and failure to use safety devices are the leading risk factors.
- Preventing RTIs requires action from different actors and the integration of safety measures into broader transport and urban development policies.
- Promoting cycling and walking as part of transport policy has other health and environmental benefits.

3.6 References

1. Peden M et al. *World report on road traffic injury prevention*. Geneva, World Health Organization, 2004 (http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/, accessed 10 November 2008).
2. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization (in press).
3. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
4. European detailed mortality database (DMDB). Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 10 November 2008)
5. Sethi D et al. *Youth and road safety in Europe*. Copenhagen, WHO Regional Office for Europe, 2007 (http://www.euro.who.int/InformationSources/Publications/Catalogue/20060601_1 accessed 10 November 2008).
6. *Handbook of transport statistics in the UNECE region*. Geneva, United Nations Economic Commission for Europe, 2006 (http://www.unece.org/trans/main/wp6/transstatpub.html#handbook, accessed 10 November 2008).
7. UNECE transport database. Geneva, United Nations Economic Commission for Europe, 2007 (http:77w3.unece/pxweb/Dialog/, accessed 10 November 2008)
8. Winston F et al. The carnage wrought by major economic change: ecological study of traffic related mortality and the reunification of Germany. *British Medical Journal*, 1999, 318:1647–1650.
9. Racioppi F et al. *Preventing road traffic injury: a public health perspective for Europe*. Copenhagen, WHO Regional Office for Europe, 2004 (http://www.euro.who.int/InformationSources/Publications/Catalogue/20041119_2, accessed 10 November 2008).
10. Sethi D et al. Reducing inequalities from injuries in Europe. *Lancet*, 2006, 368:2243–50.
11. Koupilova I et al. Injuries: a public health threat children and adolescents in the European Region. In Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002: 130–140 (Environmental Issue Report 29).
12. McKee M et al. Health policy-making in central and eastern Europe: why has there been so little action on injuries? *Health Policy and Planning*, 2000, 15.
13. Sethi D et al. Preventing the leading cause of death in young people in Europe. *Journal of Epidemiology and Community Health*, 2007, 61:842–843.
14. Road safety performance. National peer review: Russian Federation. Paris, European Conference of Ministers of Transport, 2006.
15. Strukcinskiene B et al. Traffic injury mortality in children in transitional Lithuania – a longitudinal analysis from 1971 to 2005. *Acta Pædiatrica*, 2008, 97:358–361.
16. *Panorama of transport 1990–2005*. Luxembourg, European Commission, 2007 (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-DA-07–001/EN/KS-DA-07–001-EN.PDF, accessed 10 November 2008).
17. DiGuiseppi C et al. Influence in travel patterns on mortality from injury among teenagers in England and Wales 1985–1995. *BMJ*, 1998, 16:904–904.
18. Pooley C et al. The journey to school in Britain since the1940s: continuity and change. *Area*, 2005, 37:43–53.

19. Woodcock J. Cars, corporations and commodities: consequences for the social determinants of health. *Emerging Themes in Epidemiology*, 2008, 5:4.
20. Christie N et al. Understanding high traffic injury risks for children in low socioeconomic areas: a qualitative study of parents' views. *Injury Prevention*, 2007, 13:394–397.
21. Christie N et al. *Children's road traffic safety: an international survey of policy and practice*. London, Department for Transport, 2004 (Road Safety Research Report No. 47; http://eprints.ucl.ac.uk/1211/1/2004_4.pdf, accessed 10 November 2008).
22. Edwards P et al. Deaths from injury in children and employment status in family: analysis of trends in class specific death rates. *British Medical Journal*, 2006, 333:119–122.
23. Roberts I, Power C. Does the decline in child mortality vary by social class? A comparison of class specific mortality in 1981 and 1991. *British Medical Journal*, 1996, 313:784–786.
24. *Streets ahead: safe and liveable streets for children*. London, Institute of Policy Research. 2002.
25. Leyland A et al. Cause-specific inequalities in mortality in Scotland: two decades of change. A population-based study. *BMC Public Health*, 2007, 24:172.
26. Ward H et al. *Fatal injuries to car occupants: analysis of health and population data*. London., Department for Transport, 2007 (Road Safety Research Report No. 77).
27. Clarke D et al. *A poor way to die: social deprivation and road traffic fatalities*. London, Department of Transport, 2008.
28. Haworth N, Mulvihill C. *Review of motorcycle licensing and training*. Melbourne, Accident Research Centre, Monash University, 2005 (Report No. 240).
29. Bos N et al. *Traffic safety basic facts 2007. Motorcycles and mopeds*. Loughborough, European Road Safety Observatory, 2008.
30. Gill M et al. Changes in safety on England's roads: analysis of hospital statistics. *British Medical Journal*, 2006, 333:73–75.
31. Roberts I. Death on the road to international development. *British Medical Journal*, 2005, 330:972-973.
32. Perez C et al. Motor vehicle crash fatalities at 30 days in Spain. *Gaceta Sanitaria*, 2006, 20:108–115.
33. Lopez-Valdes F et al. Evaluating the appropriateness of the injury scaling method for pediatric motor vehicle injuries. *Annals Advancement of Automative Medicine*, 2008, 56:13.
34. Rossi P et al. Road traffic injuries in Lazio, Italy: a descriptive analysis from an emergency department-based surveillance system. *Annals of Emergency Medicine*, 2005, 46:152–157.
35. Duma O. Soliciting a model of a child emergency care unit in road accidents in the year 2005. *Revista Medico-Chiruricala A Societatii de Medici si Naturalisti Din Iasi*, 2006, 110:999–1003.
36. Rusch MD et al. Psychological adjustment in children after traumatic disfiguring injuries: a 12 month follow up. *Plastic and Reconstructive Surgery*, 2000, 106:1451–1460.
37. Finkelstein E et al. *The incidence and economic burden of injuries in the United States*. New York: Oxford University Press, 2006.
38. Elvik R, Vaa T. *Handbook of road safety measures*. London, Elsevier Ltd, 2004.
39. Polinder S et al. *APOLLO: the economic consequences of injury. Final report*. Amsterdam, Eurosafe, 2008.
40. Thomas P et al. *Future research directions in injury biomechanics and passive safety research*. Loughborough, International Research Council on Biomechanics of Injury, 2006.
41. Winston F et al. Risk factors for death among older child and teenaged motor vehicle passengers. *Archives of Pediatrics & Adolescent Medicine*, 2008, 162:253–260.
42. Valencia-Martin J et al. The joint association of average volume of alcohol and binge drinking with hazardous driving behaviour and traffic crashes. *Addition*, 2008, 103:749–757.
43. Toroyan T, Peden M. *Youth and road safety*. Geneva, World Health Organization, 2007.
44. Durbin D et al. Risk of injury to restrained children from passenger airbags. *Annual Proceedings – Association for the Advancement of Automotive Medicine*, 2002, 46:15–25.
45. Liu B et al. Helmets for preventing injuries in motorcycle riders. *Cochrane Database of Systematic Reviews*, 2004, 2:CD004333.
46. *Helmets: a road safety manual for decision-makers and practitioners*. Geneva, World Health Organization, 2006 (http://www.who.int/roadsafety/projects/manuals/helmet_manual/en/index.html, accessed 10 November 2008).
47. Thompson D et al. Helmets for preventing head and facial injuries in bicyclists. *Cochrane Database of Systematic Reviews*, 1999, 4:CD001855.
48. MacKay M, Vincenten J. *Availability and affordability of routinely recommended child safety devices in 18 countries in Europe. 9th World Conference on Injury Prevention & Safety Promotion, Merida, Mexico, March 2008*. Cuernavaca, Nacional de Salud Publica, 2008.
49. Hendrie D et al. Child and family device availability by country income level: an 18 country comparison. *Injury Prevention*, 2004, 10:338–343.
50. *Keeping children safe in traffic*. Paris, Organisation for Economic Co-operation and Development, 2004.
51. *Young people's health in context. Health behaviour in school-aged children (HBSC) study: international report from the 2001/2002 survey*. Copenhagen, WHO Regional Office for Europe, 2004 (http://www.euro.who.int/InformationSources/Publications/Catalogue/20040601_1, accessed 10 November 2008).
52. *Promoting and creating built or natural environments that encourage and support physical activity. NICE Public health guidance 8*. London, NICE, 2008 (http://www.nice.org.uk/nicemedia/pdf/PH008guidance.pdf, accessed 10 November 2008).
53. Ramos P et al. Young people's perceptions of traffic injury risks, prevention and enforcement: A qualitative study. *Accident Analysis and Prevention*, 2008, 40:1313–1319.
54. Kimberlee R. Streets ahead on safety: young people's participation in decision-making to address the European road injury 'epidemic'. *Health & Social Care in the Community*, 2008, 16:322–328.
55. Salman and Friends [web site]. Manchester, Divesafe, 2006 (http://www.salmanandfriends.co.uk, accessed 10 November 2008).
56. Bunn F et al. Area-wide traffic calming for preventing traffic related injuries. *Cochrane Database of Systematic Reviews*, 2003, CD003110.
57. *Cost effective EU transport safety measures*. Brussels, European Transport Safety Council, 2003.
58. Pilkington P. Reducing the speed limit to 20mph in urban areas. *BMJ*, 2000, 320:1160.
59. Ameratunga S et al. Death and injury on roads. *BMJ*, 2006, 333:53–54.
60. Roberts I et al. War on the roads. *BMJ*, 2002, 324:1107–1108.
61. *European drivers and road risk. Part 1. Report on principal results*. Paris, SARTRE 3 consortium, 2004 (SARTRE3 reports).

62. *Road safety: European Parliament says more action needed*. Brussels, European Parliament, 2007 (http://www.europarl.europa.eu/news/expert/infopress_page/062-1938-015-01-03-910-20070112IPR01913-15-01-2007-2007false/default_en.htm, accessed 10 November 2008.
63. *Working to prevent and control injury in the United States – Fact book for the year 2000*. Atlanta, National Center for Injury Prevention and Control, 2000.
64. Miller T, Levy D. Cost-outcome analysis in injury prevention and control: eighty-four recent estimates for the United States. *Medical Care*, 2000, 38:562–582.
65. Graham J et al. The cost–effectiveness of air bags by seating position. *JAMA*, 1997, 278:1418–1425.
66. Segui-Gomez M et al. Where children sit in motor vehicles: a comparison of selected European and American cities. *Injury Prevention*, 1998, 4:98–102.
67. Karkhaneh M et al. Effectiveness of bicycle helmet legislation to increase helmet use: a systematic review. *Injury Prevention*, 2006, 12:76–82.
68. Royal S et al. Non-legislative interventions for the promotion of cycle helmet wearing by children. *Cochrane Database of Systematic Reviews*, 2005, 2:CD003985.
69. Kwan I, Mapstone J. Interventions for increasing pedestrian and cyclist visibility for the prevention of deaths and injuries. *Cochrane Database of Systematic Reviews*, 2002, 2:CD003438. pub003432.

WHY CHILDREN NEED SPECIAL ATTENTION

CHAPTER 4
DROWNING

4.1 Introduction

Water brings a great deal of pleasure, excitement and adventure to most children, but more than 5000 drown each year in the WHO European Region: about 14 children each day. Drowning is the second most important cause of injury death in children aged 0–19 years in Europe (Table 2.1) and the leading cause in countries such as Albania, Kyrgyzstan and Uzbekistan (Annex 4, Fig. 3). Further, for each child that dies from drowning, at least two are estimated to suffer lifelong disability, including neurological damage, with the majority affecting children under 5 years of age *(1)*.

Drowning has been defined as the process of experiencing respiratory impairment from submersion/immersion in liquid *(2)*. It can happen silently, within seconds. Young children can drown in as little as 2 cm of water at the bottom of a bucket, in the bath, a portable swimming pool or an uncovered well, and older children, in lakes, rivers and canals where they swim *(3)*.

Most children drown in or around the home, especially during everyday activities such as playing, bathing and exploring their surroundings. In some LMICs in Europe, drowning commonly occurs in ponds, ditches, lakes, rivers and water collectors above and below ground, such as buckets, barrels and wells. In HICs, most drownings occur in recreational locations such as swimming pools. Children in rural communities are at greater risk of drowning than those in urban settings. Ireland, for example, showed a significant rural–urban difference in drowning deaths of young people aged under 25 years in 1980–2000 *(4)*.

Children who survive drowning may be severely disabled through brain damage and require lifelong financial and health care support, estimated to be the highest average lifetime costs of any injury *(5)*. Such circumstances can devastate families emotionally and economically, creating a crisis that can often destroy the family (Box 4.1).

4.2 Burden in the European Region

4.2.1 Mortality

Drowning death rates vary widely across the European Region, demonstrating great inequity. Children in the country with the highest rate, Kazakhstan, have 20 times the risk of drowning of children in the country with the lowest rate, the United Kingdom (Fig. 4.1). The rates of the best performing countries in Europe are the lowest worldwide, but other countries in the Region have some of the highest drowning rates in the world, equivalent to those in LMICs in Africa and the eastern Mediterranean. If all countries in the Region were able to achieve the same rates as the United Kingdom, more than 4500 children's lives could be saved each year: 9 out of 10 drowning deaths could be averted (Table 8.3).

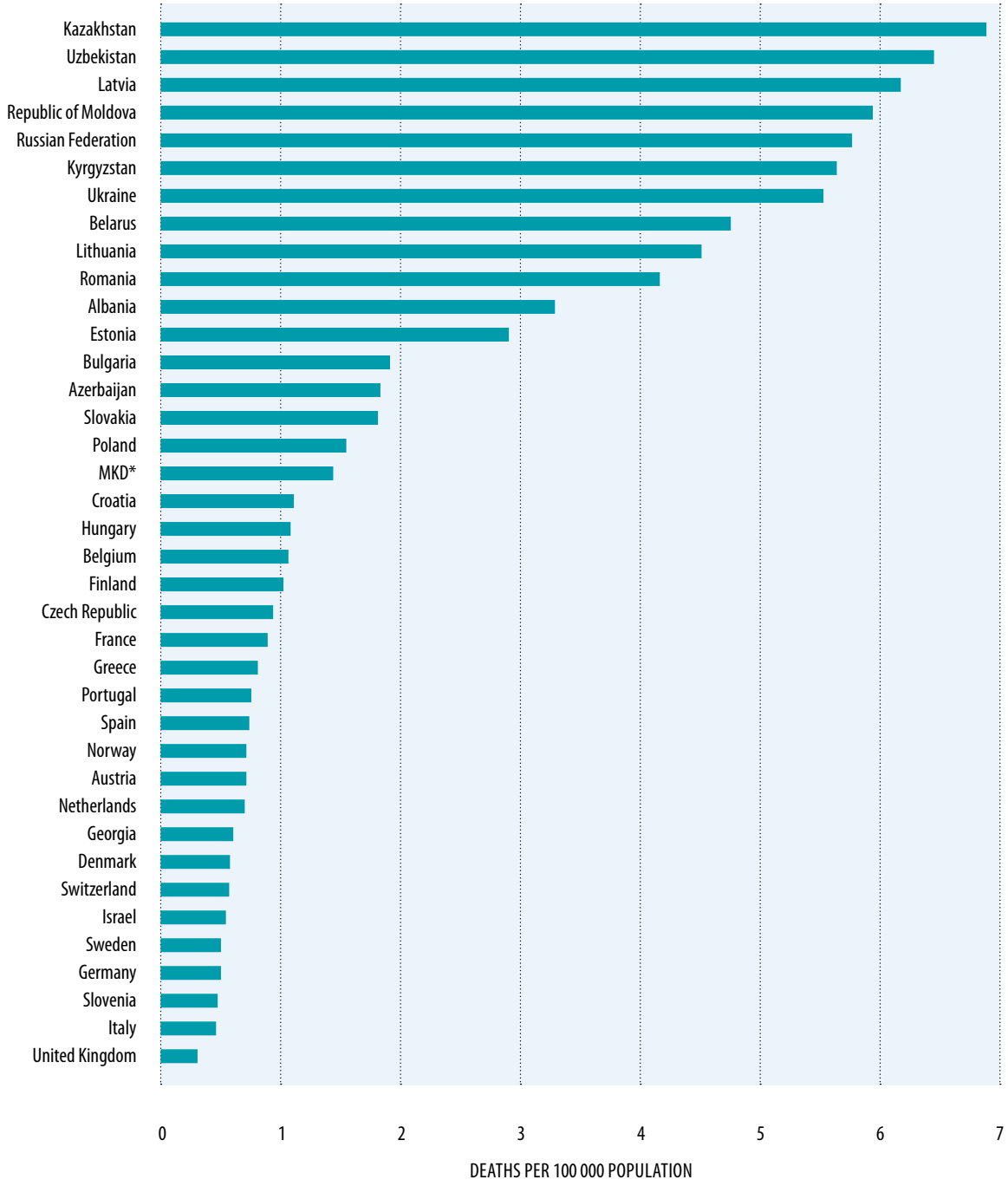
BOX 4.1

Key facts for drowning events in the WHO European Region

- More than 5000 children aged 0–19 years die from drowning each year in the WHO European Region.
- Children who survive may be severely disabled and require lifelong financial and health care support.
- Inequalities exist, including the twentyfold difference in deaths between the countries with the highest and lowest rates.
- The poorest people in countries are up to 11 times more vulnerable to drowning than the rich.
- If rates in all countries matches those of the countries with the lowest rates, 9 out of 10 deaths could be averted.
- Some interventions have been proved to reduce drowning in children: removing or covering water hazards, installing four-sided pool fencing, using personal flotation devices and performing immediate resuscitation.

Figure 4.1

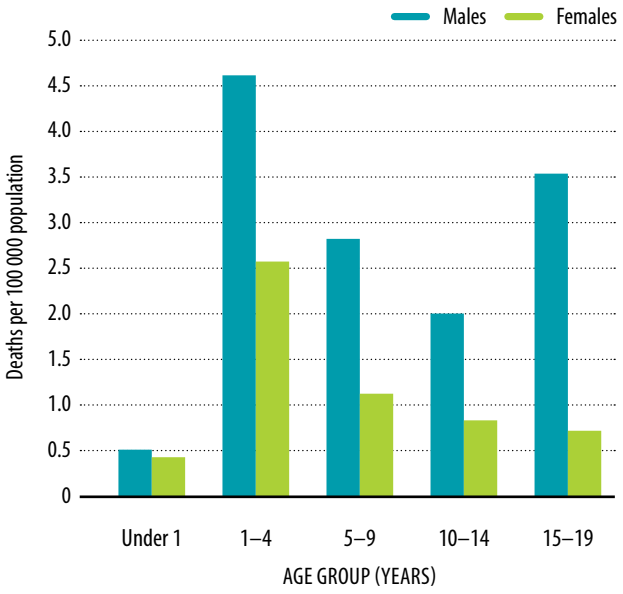
Average standardized mortality rates for drowning in children aged 0–19 years in the WHO European Region, 2003–2005 or most recent three years



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: European detailed mortality database (DMDB) [online database] *(6)*.

Among children in the Region aged over 1 year, boys are at greater risk of drowning than girls, with the highest risk for boys aged 1–4 and 15–19 years (Fig. 4.2). Overall, drowning poses the greatest risks to young children, and is the leading cause of unintentional injury death in children aged 1–4 years (Annex 4, Table 4).

Figure 4.2
Age- and gender-specific mortality rates for drowning in children in the WHO European Region, 2003–2005 or most recent three years



Source: The global burden of disease: 2004 update *(7)*.

4.2.2 Morbidity

The number of non-fatal drowning incidents is unknown in many countries, as they may go unreported or misclassified. Again, deaths are the tip of the iceberg. In the Netherlands for example, for every childhood drowning fatality, there are estimated to be five hospital admissions and six visits to an emergency department *(8)*.

Because nearly half the children who lose consciousness after immersion eventually die *(9)*, prompt resuscitation is critical to survival. Events occurring in the first 10 minutes largely determine the likelihood of a child's survival. Consciousness is lost about 2 minutes after immersion and irreversible brain damage occurs after 4–6 minutes.

The outcome for most children is determined by their status on arrival at the emergency department, and medical and intensive care treatment appears to have relatively little impact on outcome. Thus, prevention is key to reducing hospital admissions and deaths from drowning, and immediate resuscitation improves outcomes *(10)*. The effects of immersion in cold water, such as hypothermia, have been found to accelerate the process of drowning by impeding the victim's physical abilities. Children are especially vulnerable to the effects of cold-water immersion, due to their smaller body size and greater susceptibility to hypothermia *(11)*.

BOX 4.2

Using a surveillance system to identify the location and costs of drowning in the Netherlands

The setting of a drowning depends on the country context. In the Netherlands, for example, where there are many canals and rivers, an average of 150 children aged 0–18 years visited an emergency department for non-fatal drowning each year during 2002–2006. Most of these events occurred in canals, rivers and streams (22%) and swimming pools (22%), followed by small ponds and inflatable swimming pools around the home (10%) and bathtubs in the home (8%).

Costs were calculated for these drowning events, which required either an emergency department visit or hospitalization. The annual average direct medical costs for the 150 non-fatal drowning incidents totalled €490 000.

These data were used to inform prevention strategies such as: prioritizing supervision in swimming pools, targeting locations for public campaigns, as well as communicating with the media and policy-makers.

Source: Dutch Injury Surveillance System 2002–2006 *(8)*.

4.3 Why children are at risk

Drowning is linked to exposure in unsafe environments, and factors such as age and development, gender and circumstances in countries.

Drowning incidence is closely related to children's age and stage of development. Infants may be left alone in the bath (for example when caregivers are called away) or supervised by another child. Toddlers are particularly at risk, as they are both mobile and curious, and may wander away from the supervising caregiver to fall or climb into a water source *(12,13)*. Young people are prone to risky behaviour, including alcohol use and behaviour influenced by their peers *(14,15)*.

Among children aged over 1 year, boys are at greater risk of drowning than girls, as a result of their greater exposure to water and risky behaviour while swimming and boating *(14)*.

Risk also varies with country income level. Children and teenagers under 20 years of age from LMICs are 7 times more likely to drown than those in HICs, and 14 times more likely if they are aged 10–14 years (Table 4.1).

Table 4.1
Age-standardized death rates from drowning by age group with rate ratios for LMICs and HICs, WHO European Region

	Age groups (years)					
	<1	1–4	5–9	10–14	15–19	<20
Death rates in:						
HIC	0.48	1.09	0.39	0.23	0.68	0.56
LMIC	1.83	9.30	3.83	3.12	2.12	3.95
Rate ratio:	3.85	8.53	9.77	13.65	3.11	7.00

Source: The global burden of disease: 2004 update *(7)*.

4.3.1 Socioeconomic determinants

Socioeconomic class and poverty are linked to increased drowning risk for children, and studies show that the lowest social classes may have five times the risk of the highest and for the unemployed this is 11 times the risk of the highest *(15,16)*. Children from ethnic minority groups have 2–4 times the risk of other children; the figure in the Netherlands, for example, is almost three times the risk *(17)*. In Germany, immigrant boys aged 1–4 years had higher rates of drowning than native-born children *(18)*. This is likely to be partly attributable to socioeconomic deprivation, with less access to swimming lessons, and to cultural differences in perceptions of the risk of drowning and usefulness of swimming *(19,20)*.

4.3.2 Economic change

The eastern part of the European Region has changed rapidly from centrally planned to market-based economies. Not all societies have implemented safety regulations and standards to keep abreast of the changes *(21)*.

For example, drowning is the major cause of injury death in those aged 0–19 years in Kazakhstan. In this country, children from both ends of the financial spectrum are at higher risk from drowning (G. Ussatayeva, personal communication, 2008). Those from the poorest families continue to be exposed to open water environments, such as irrigation ditches; increasingly wealthy people have built houses with swimming pools, but there are few regulations on pool fencing and safety equipment.

4.3.3 Tourism

The EU's enlargement policies have created more open borders, and access to low-cost airlines has increased Europeans' travel to more waterside locations for family holidays. Nearly 70% of Europeans spend their holidays by a sea or lake, most visiting other European countries, and 25% of these tourists are travelling with children under 18 *(22)*.

These destinations offer exciting but unfamiliar surroundings with different safety standards, resulting in children's exposure to unknown dangers *(23–25)*. For the United Kingdom, for example, more children drown abroad than at home *(26)*. In the coastal region of Portugal, 72% of the children admitted to hospital for a submersion incident in a swimming pool were foreigners *(27)*.

4.3.4 Medical conditions

Epilepsy or seizure disorder is known to increase the risk of fatal drowning in all waters, including that in bathtubs and swimming pools, and ponds and other natural bodies of water. Research in Norway found that children with epilepsy had a significantly higher risk of submersion and drowning than others, in both bathtubs and swimming pools *(28)*. Autism and certain cardiac arrhythmias are also likely to increase the risk of drowning *(29)*.

4.3.5 Supervision

Inadequate supervision is associated with both fatal and non-fatal drowning, particularly in children under 5 who are exposed to pools or other expanses of water. Adult supervision is more effective than that provided by older children *(30)*.

4.3.6 Alcohol

Alcohol influences balance, coordination and judgment, and sun exposure and heat heighten its effects. Drinking by a parent or guardian may cause a lapse of attention that contributes to child drowning. Alcohol has also been associated with 25–50% of adolescent and adult deaths linked with water recreation in the United States *(31)*. A study of teenage diving victims with severe spinal injuries showed that alcohol was a factor in 49% of cases *(32)*. In Finland, more than 63% of boating and personal-water-craft fatalities were associated with alcohol use *(33)*.

4.3.7 Transport

Children, as well as adults, are at increased risk of drowning while being transported on larger boats and ferries that are overcrowded or unsafe, or have not undergone disaster preparedness. In September 1994, a disaster in the Baltic Sea resulted in the deaths of 852 of the 989 people on board a ferry; all 11 children aged under 12 and 23 of the 27 people aged 12–18 died *(34)*.

4.3.8 Climate change

Events associated with climate change may put children at risk. Floods are the most common natural disaster in Europe, and have complex and far-reaching adverse consequences for health, including drowning *(35)*. Groups

that are particularly vulnerable to these effects include children, ethnic minorities and those with low incomes, who may live in the highest-risk areas.

Further, temperatures in Europe have risen, with periodic heat-waves. This not only affects the elderly population but also attracts more children to cool off in nearby water environments, thereby increasing their risk of drowning. Peaks in child drowning deaths have been observed in countries during unseasonably warmer weather, as children and families flock to beaches, swimming pools and other open water sources, as has been reported in the media, for example, in France, United Kingdom, Netherlands and Kazakhstan *(36,37)* (Eyer-Zoet, Consumer Safety Institute, Netherlands, personal communication, 2006).

4.4 Prevention

The magnitude and burden of drowning have great impact on children and their families throughout the Region, with an additional burden on children from lower socioeconomic environments and families that have lower education levels or are immigrants.

The domain of water safety has a wide scope. The construction and management of swimming pools, lifeguard training and qualifications, coast guard rescues, appropriate signage in water locations, swimming education in and out of schools, requirements for ferry boat safety, and the design and use of personal floatation devices are the responsibilities of different entities in different countries. These include: government departments (such as those for health, education, recreation and tourism, trade and industry, disaster services), international and national organizations (such as the Red Cross and the Royal Life Saving Society), private enterprises (such as manufacturers of pools, life jackets and water recreation equipment). A coordinated approach, involving many sectors, is optimal to implement comprehensive injury prevention efforts *(38)*. Owing to a lack of ownership by any one sector, the onus falls on the health sector to lead the coordination of such a response in many countries *(39–41)*.

Effective prevention strategies can reduce drowning, as in the United Kingdom, where the combination of legislation, environmental modification and education has reduced death rates (Box 4.3). Similarly, in the century between 1900 and 2000, death rates from drowning for all ages in the Netherlands dropped from 14.4 per 100 000 population to 0.6 per 100 000 population. Much of the decrease has been attributed to a range of preventive measures *(2)*.

4.4.1 Engineering and environmental approaches

Good evidence supports building and maintaining four-sided fenced private pools to prevent drowning. Enclosing the pool (isolation fencing) is better than enclosing the property and the pool together because it further reduces the risk of exposure. Recent European research confirms that, to be most effective, fences should be at least 1.1 m high, without footholds *(43)*. Ornamental iron bar fences are attractive, provide visibility and are harder to climb than chain-link fences, which young children can easily scale *(43)*. Barriers may also be formed between children

BOX 4.3

Preventing drowning in children in the United Kingdom – Comments from the Royal Society for the Prevention of Accidents

What are the reasons why the numbers of children drowning in the United Kingdom are lower than those of other countries in the Region?

(1) Exposure to water
Children in the United Kingdom are less exposed to water environments There are few domestic swimming pools or large open water bodies and there is also less tradition of swimming in inland lakes. The generally poor weather in the United Kingdom, compared to that of southern European countries, also has contributed to swimmers' exposure levels. During particularly hot summers, drowning rates increase. Where people swim in public swimming pools or at beaches, the locations are well supervised by trained lifeguards.

(2) Health education and awareness raising
A number of initiatives throughout the country contribute to controlling the risk of drowning. These include Swim 4 Free and the schools' national curriculum, which includes requirements for children to be able to swim 25 metres by the age of 11. The United Kingdom led the way on water safety information with its guidance for swimming pool management, which most other European countries do not have in place.

(3) Response systems
Good response systems are in place all over the country, including pool lifeguards, coast guards and the national lifeboat service.

The emergency services are supplemented by large number of professional life guards on beaches.

There are still some major areas of concern, which include the number of British tourists drowning while on holiday abroad and the increase of drowning in migrant workers in the United Kingdom.

Source: Can the home ever be safe *(42)*.

and water in other locations such as ponds, construction ditches and canals. Data from France suggest that the 2006 law requiring a barrier around private pools has reduced fatal drownings of children *(36)*.

Experts agree that reducing children's exposure to water sources can help prevent drowning, so unnecessary accumulations of water in portable swimming pools, ponds, buckets, etc. should be drained *(44,45)*. Building safe crossings over canals and irrigation ditches and installing piped water systems to reduce exposure to open bodies of water also help reduce exposure.

Experts recommend the use of a personal floatation device (PFD) for boating and other water recreation activities to help prevent drowning *(11)*. Providing dedicated, well-marked swimming areas free of hazards can also help *(45)*. The German Red Cross has done this in many open-water areas in Germany, and recommended action for water recreation providers in Europe *(25)*.

Further, creating a barrier between children and water-collection containers by covering them with heavy grills reduces the risk of drowning. Many children have drowned in open wells and reservoirs in rural areas *(27)*. In Portugal, a national law was enacted in 2002 requiring newly constructed well access points to be a minimum of 80 cm from the ground and have secure covers. Despite this improvement, many old and abandoned wells still pose a great risk to children, as no regular inspection or enforcement of the law is carried out. The hazard has not been adequately addressed and, according to the Portuguese Association for Child Safety and Injury Control, nine children died in wells in the first eight months of 2008.

BOX 4.4

Drowning prevention by legislating for safer private swimming pools: experience in France

In France, drowning is an important public health problem since it is responsible for more than 400 unintentional deaths every year. In June–September 2006, 1207 unintentional drowning events were recorded, 401 (33%) of which were fatal; 166 drownings occurred in private swimming pools, where over half of victims were aged under 6 years: 94 incidents resulting in 21 deaths.

A 2003 French law required that each owner of a private swimming pool (whether for individual or collective use) must fit it with a standardized safety device by 1 January 2006. Four different types of security devices can be used: a roller shutter, a shelter, a fence or an alarm. The law is supported each year by a national prevention campaign, reminding parents that children must always be supervised, even with safe swimming pools.

The number of deaths among young children since 2006, after the implementation of the law, was compared with the 2001–2004 period. This showed that, in spite of a marked increase in exposure due to a rise of 50% in private swimming pools over the study period, the annual number of deaths in children under 6 remained unchanged. An analysis of individual cases suggests that the implementation of the safety measures prevented some deaths. Of the four measures available, however, detection alarms were found to be unreliable and the Commission for Consumer Security of called for a change in the law in 2008.

Sources: Institut national de prévention et d'éducation pour la santé (http://www.inpes.sante.fr) and Commission de la Sécurité des Consommateurs (http://www.securiteconso.org).

4.4.2 Legislation and standards

Making and enforcing legislation requiring isolation fencing for all private, public and semi-public swimming pools, including adequate education for the public, have been proved to be effective. Such legislation was instrumental in reducing child deaths in Queensland Australia *(46–48)* and, according to early evidence, fatal child drownings in France *(36)* (Box 4.4). Austria, the Czech Republic, Italy, Norway and Sweden have national laws requiring barrier fencing for public pools; only France, however, has legislation requiring such barriers for private pools *(49)*.

It is estimated that 85% of boating-related drowning incidents each year could be prevented if the victims were wearing PFDs *(50)*. Evidence from other areas of injury prevention suggests that legislative requirements increase the use of such protective devices. Estonia and Portugal have legislation requiring use of PFDs, but it either does not cover all boating situations or is not well enforced. Other countries in the Region have not yet taken up this measure *(49)*.

4.4.3 Education and skill development

Children over 5 years should have opportunities for swimming instruction and skills improvement. Swimming instruction improves the ability to dive, swim underwater, breathe correctly and tread water. Swimming ability should be promoted as a necessary component of water competence, but with the understanding that ability alone is not sufficient to prevent drowning *(51,52)*. Austria, Belgium, the Czech Republic, Estonia and Sweden, for example, all have made water safety education, including swimming lessons, a compulsory part of the school curriculum *(49)*.

Swimming in designated areas, with a lifeguard present, greatly improves the outcome of a non-fatal drowning because immediate resuscitation is strongly related to a positive outcome *(53)*. The presence of lifeguards deters risky behaviour and prevents dangerous events in the same way that police presence deters crime. For every water rescue lifeguards make, they are estimated to perform about 49 preventive actions *(11)*.

Thus, training and employing lifeguards at beaches and public swimming pools and ensuring adherence to performance standards are important parts of preventing drowning. Several countries – including Estonia, Greece, Italy, Poland and Spain – have laws requiring a minimum number of lifeguards on beaches or other specified areas for water leisure activities, but others have yet to adopt this measure *(49)*.

Further, parents and caregivers should learn basic life-saving and first-aid skills. Without immediate first aid

(including basic cardiopulmonary resuscitation) subsequent advanced and invasive life support techniques are of little value in most drowning cases *(54,55)*. The general community, including older children, can be trained in cardiopulmonary resuscitation. As mentioned, immediate resuscitation initiated by bystanders increases children's survival; they usually recover after hospital treatment *(56)*. Finally, drowning tragedies such as the cases described in Box 4.5 haunt families, but are being communicated to raise communities' awareness of the need for drowning prevention and enhanced risk perception.

BOX 4.5

Case histories from Kazakhstan

Working mother loses 3 children to drowning on the same day
Young children often accompany their mothers as they work in the fields in Kazakhstan. One mother brought her children to the cotton field where she was working and tragically lost all three to drowning. She left them playing near an irrigation ditch, and the youngest child fell in. The two older ones tried to save him, but also fell into the water and all died.

Two children from Shymkent drown in irrigation ditch
In Shymkent, two 4-year-olds drowned in an irrigation ditch. The two boys were neighbours who often played together, but one evening did not come home as usual. At 19:00, their parents started searching for them and the bodies were found at 2:00 in a ditch near their homes. Since the beginning of 2002, five young children have drowned in such ditches.

Sources: G. Ussatayeva, personally communication, 2008 and Gazeta.kz [web site] *(57)*.

4.4.4 Measures to avoid

An alarm and cover should not be used in place of a four-sided fence around a swimming pool, because they may not be used appropriately and consistently *(52)*. Pool covers, especially soft or solar covers, have also been found to be an additional hazard, as children trying to walk on them have disappeared from sight, causing a delay in rescue *(58)*.

Swim seats are not recommended for use in learning to swim. Bath seats are not recommended for use in bathing young children; as adults feel an increased sense of safety, they may leave children unattended and thus at risk *(59,60)*.

Floaters or water wings are recommended as supports for learning to swim because they enable children to keep their balance in the water. Nevertheless, this does not remove the need to monitor the children using them when in water of all depths *(59)*.

4.5 Conclusions

Drowning is the second most important cause of injury deaths to children in the European Region, and the leading cause of childhood death in some countries. Action to enhance safety is essential to ensuring that water environments are beneficial for both children and adults. Working with the various sectors with roles in water environments while using approaches combining engineering and environmental modifications, legislation and education will help prevent drowning (Box 4.6).

BOX 4.6

Key messages for policy-makers

- Fatal and non-fatal drowning events are strongly linked to children's exposure to various water environments.
- Implementing and enforcing approaches of proven efficacy is critical to reducing childhood drowning. These include removing or covering water hazards, installing four-sided fencing around swimming pools, using personal flotation devices and providing immediate resuscitation to drowning victims.
- Children drown in a diverse range of settings and circumstances. A collaborative approach to prevention and care is critical to ensuring that this important cause of childhood injury is addressed and that key agencies share the responsibility for its management.

4.6 References

1. Meyer R et al. Childhood drowning. *Pediatrics in Review*, 2006, 27:163–169.
2. Van Beeck E. A new definition of drowning: towards documentation and prevention of a global public health problem. *Bulletin of the World Health Organization*, 2005, 83:853–856.
3. Vincenten J. *Priorities for child safety in the EU: an agenda for action*. Amsterdam, European Child Safety Alliance, EuroSafe, 2004.
4. Boland M et al. Urban–rural variation in mortality and hospital admission rates for unintentional injury in Ireland. *Injury Prevention*, 2005, 11:38–42.
5. Watson W, Ozanne-Smith J. *The cost of injury to Victoria. Monash University accident research report 124*. Clayton, Monash University, 1997
6. European detailed mortality database (DMDB) [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 13 November 2008).
7. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
8. *Dutch Injury Surveillance System 2002–2006*. Amsterdam, Consumer Safety Institute, 2008.
9. Harbourview Injury Prevention and Research Center/Cochrane Collaboration. *Systematic Review Database*. Seattle, University of Washington, 2001.
10. *Best practices. Poisoning interventions*. Seattle, Harborview Injury Prevention Research Centre, 2008 (http://depts.washington.edu/hiprc/practices/topic/poisoning/packaging.html, accessed 06 April 2008).
11. *WHO Guidelines for safe recreational water environments. Vol. 1. Costal and fresh waters*. Geneva, World Health Organization, 2003.
12. Cass D et al. Childhood drowning in New South Wales 1990–1995: a population-based study. *The Medical Journal of Australia*, 1996, 165:610–612.

13. Blum C, Shield J. Toddler drowning in domestic swimming pools. *Injury Prevention*, 2000, 6:288–290.
14. Kumpula H, Paavola M. *Injuries and risk-taking among young people in Europe – The European situational analysis. EU-Project AdRisk*. Helsinki, National Public Health Institute, 2008 (http://www.adrisk.eu.com, accessed 13 November 2008).
15. Roberts I. Cause specific social class mortality differentials for child injury and poisoning in England and Wales. *Journal of Epidemiology and Community Health*, 1997, 51:334–335.
16. Edwards P et al. Deaths from injury in children and employment status in family: analysis of trends in class specific rates. *British Medical Journal*, 2006,333:119–122.
17. Stirbu I et al. Injury mortality among ethnic minority groups in the Netherlands. *Journal of Epidemiology and Community Health*, 2006, 60:249–255.
18. Kahl H et al. Injuries among children and adolescents (1–17 years) and implementation of safety measures. Results of the nation wide German Health Interview and Examination Survey for Children and Adolescents *Bundesgesundheitsbl-Gesundheitsforsch-Gesundheitsschutz*, 2007, 50:718–727.
19. Klein Wolt K et al. Veiligheidsbarometer allochtone ouders van 0–12 jarigen. *Nederlands congres Volksgezondheid*. Amsterdam, Stichting Consument en Veiligheid, 2008.
20. van Aken C et al. Veiligheidsbarometer autochtone ouders van 0–12 jarigen Amsterdam. *Stichting Consument en Veiligheid*, 2008.
21. Koupilova I et al. Injuries: a public health threat children and adolescents in the European Region. In Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002: 130–140 (Environmental Issue Report 29).
22. Schmidt H. *How Europeans go on holiday. Statistics in focus: industry, trade and services*. Luxembourg, EUROSTAT, 2002.
23. Alexe D et al. *Epidemiology of unintentional drowning deaths in Greece. World Congress on Drowning*. Amsterdam: Stichting Foundation Drowning, 2002.
24. McInnes R et al. Unintentional injury during foreign travel: a review. *Journal of travel medicine*, 2002, 6:297–307.
25. Norman N, Vincenten J. *Protecting children and youth in water recreation: safety guidelines for service providers*. Amsterdam, European Child Safety Alliance, EuroSafe, 2008.
26. Silbert J et al. Preventing deaths by drowning in children in the United Kingdom: have we made progress in 10 years? Population based incidence study. *BMJ*, 2002, 324:1070–1071.
27. Tapadinhas F, et al. Children submersion accidents in the East of Algarve. *Child Health Magazine*, 2002, 28:19–29.
28. Diekema D et al. Epilepsy as a risk factor for submersion injury in children. *Pediatrics*, 1993, 91:612–616.
29. Ackerman M et al. A novel mutation in KVLQT1 is the molecular basis of inherited long QT syndrome in a near-drowning patient's family. *Pediatric Research*, 1998, 44:148–153.
30. Quan L et al. Ten-year study of pediatric drownings and near drownings in King County, Washington: lessons in injury prevention. *Pediatrics*, 1989, 83:1035–1040.
31. Smith G, Kraus J. Alcohol and residential, recreational, and occupational injuries: a review of the epidemiologic evidence. *Annual Reviews of Public Health*, 1988, 9:99–121.
32. DeVivo M, Sekar P. Prevention of spinal cord injuries that occur in swimming pools. *Spinal Cord*, 1997, 35:509–515.
33. Lunetta P et al. Water traffic accidents, drowning and alcohol in Finland, 1969–1995. *International Journal of Epidemiology*, 1998, 27:1038–1043.
34. Nurmi L. The Estonia disaster. National interventions, outcomes and personal impacts. In: Zinner E, Williams M, eds. *When a community weeps. Case studies in group survivorship*. London, Brunner/Mazel, Taylor & Francis Group, 1998:49–72.
35. Hajat S et al. The human health consequences of flooding in Europe and the implications for public health: a review of the evidence. *Applied Environmental Science and Public Health*, 2003, 1:13–21.
36. Thélot B et al. *Surveillance épidémiologique des noyades. Enquête NOYADES 2006*. Saint-Maurice, Institut de veille sanitaire, 2008 (http://www.invs.sante.fr, accessed 13 November 2008).
37. Royal Society for the Prevent of Accidents and Royal National Lifeboat Institution – Inland Water Monitoring Database [online database]. Birmingham, Royal Society for the Prevention of Accidents, (http://www.rospa.com/leisuresafety/water/index.htm).
38. MacKay M, Vincenten J. *Action planning for child safety: a strategic and coordinated approach to reducing the number one cause of death for children in Europe*. Amsterdam, European Child Safety Alliance, EuroSafe, 2007.
39. Zwi A. Injuries, inequalities and health: from policy vacuum to policy action. In Leon D, Walt G, eds. *Poverty, inequality and health*. Oxford, Oxford University Press, 2002:263–282.
40. McKee M et al. Health policy-making in central and eastern Europe: why has there been so little action on injuries? *Health Policy and Planning*, 2000, 15.
41. *WHO Regional Committee for Europe resolution RC58/R9 on stewardship/Governance of health systems in the WHO European Region*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/Document/RC58/RC58_edoc09.pdf, accessed 13 November 2008).
42. *Can the home ever be safe: the need to improve safety in the built environment of homes and gardens*. Birmingham, Royal Society for the Prevention of Accidents, 2005.
43. Neto C et al. *Dimensions and design of swimming pool fences and balcony and stair barriers to protect children from falling and from passing through below or above*. Brussels, ANEC, 2008.
44. Rabinovich B et al. Young children's ability to climb fences. *Human Factors*, 1994, 361994:733–744.
45. Staines C et al. *Child and early adolescent drowning in developing communities: Victoria, a case study*. Melbourne, Australia, Accident Research Centre, Monash University, 2008.
46. Fergusson D et al. The safety standards of domestic swimming pools 1980–1982. *New Zealand Medical Journal*, 1983, 96:93–95.
47. Logan P et al. Childhood drowning and fencing of outdoor pools in the United States. *Pediatrics*, 1998, 101:E3.
48. Morrison L et al. Achieving compliance with pool fencing legislation in New Zealand: a survey of regulatory authorities. *Injury Prevention*, 1999, 5:114–118.
49. MacKay M, Vincenten J. *Child safety summary report card for 18 countries – 2007*. Amsterdam, European Child Safety Alliance, 2007.
50. *Boating statistics – 2005*. Washington, DC, US Coast Guard, Department of Homeland Security, 2006 (http://www.uscgboating.org/statistics/Boating_Statistics_2005.pdf, accessed 13 November 2008).

51. Yang L et al. Risk factors for childhood drowning in rural regions of a developing country: a case–control study. *Injury Prevention*, 2007, 13:178–182.
52. Brenner R. Prevention of drowning in infants, children, and adolescents. *Pediatrics*, 2003, 112:440–445.
53. Branche C, Stewart S. *Lifeguard effectiveness: a report of the working group*. Atlanta, Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2001.
54. Kyriacou D et al. Effect of immediate resuscitation on children with submersion injury. *Pediatrics*, 1994, 94:137–142.
55. Wigginton J. The key role of layperson actions in drowning incidents. *First World Congress on Drowning, Amsterdam, 26–28 June 2002*.
56. Soar J et al. European Resuscitation Council Guidelines for Resuscitation 2005. Section 7. Cardiac arrest in special circumstances. *Resuscitation*, 2005, 67(S61), S153-S170.
57. Gazeta.kz [web site]. Almaty, Gazeta.kz internet agency, 2002 (http://eng.gazeta.kz/, accessed 13 November 2008).
58. Sulkes S, van der Jagt E. Solar pool blankets: another water hazard. *Pediatrics*, 1990, 85:1114–1117.
59. *Opinion on the Safety of Child Bath Aids (bath seats, bath rings, reclining bath seats, bath hammocks, bath pads, bathtubs for children). Consumer Code, and Specifically Articles L.224–1, L.224–4, R.224 – 4 and R.224–7 to R.224–12, petition no. 00–038 and 01–052*. Paris, Consumer Safety Commission, 2003. (http://www.securiteconso.org/org/article368.html, accessed 10 November 2008)
60. Byard R, Donald T. Infant bath seats, drowning and near-drowning. *Journal of Paediatric Child Health*, 2004, 40:305–307.

WHY CHILDREN NEED SPECIAL ATTENTION

CHAPTER 5
POISONING

5.1 Introduction

Poisoning, the third leading cause of unintentional injury deaths in children in the European Region, is responsible for 3000 deaths per year: 7% of all unintentional injury deaths *(1)*. Non-fatal poisonings are even more numerous and an important cause of ill health and long-lasting disability. Every year, millions of calls are made to poison control centres and tens of thousands of children are admitted to emergency departments because they have inadvertently consumed some type of toxic substance. Many diverse substances – ranging from medications to household chemicals, solvents, fuels and pesticides – are toxic if ingested in sufficient quantities *(2)*. Thus, the home and its surroundings can be a dangerous place for children; most unintentional poisonings, however, can be prevented (Box 5.1).

The term poisoning refers to an injury sustained due to exposure to a substance that causes cellular injury or death *(2,3)*. Poisons can be ingested, inhaled, injected or absorbed. Exposure may be acute or chronic, but this chapter addresses acute exposure. The severity of poisoning incidents varies and is influenced by factors such as the nature of the poison, its formulation, the dose taken, the route of exposure and the age of the child. The rapidity of the first-aid or health-care response is a critical factor in reducing absorption or neutralizing the toxic substance. This chapter does not deal with food poisoning, since it is generally treated as an infectious disease, or bites from venomous animals, as they are relatively uncommon in the European Region.

BOX 5.1

Key facts on unintentional poisoning

- Poisoning is the third leading cause of unintentional injury death, with 3000 deaths from acute poisoning in the WHO European Region in 2004.
- There is a thirtyfold difference between countries with the highest and lowest rates, and 9 out of 10 poisoning deaths occur in the LMICs in the Region.
- If all countries had the same rate as the country with the lowest, 7 out 10 deaths could be averted.
- Environmental modifications – such as using child-resistant closures and safe storage, reducing the availability of toxic substances – and establishing poison control centres are good investments for prevention.

5.2 Burden in the Region

5.2.1 Mortality

Poisoning mortality varies widely in the Region: thirtyfold between the countries with the lowest and the highest rates (Fig. 5.1). The LMICs in the Region suffer 93% of poisoning deaths and death rates for those under 20 that are 9.2 times those in HICs. (Table 5.1). Throughout the Region, the rate ratio for deaths is highest in those aged under 1 year and decreases with age *(1)*.

Table 5.1
Age-standardized death rates from drowning by age group with rate ratios for LMICs and HICs, WHO European Region

	Age groups (years)					
	<1	1–4	5–9	10–14	15–19	<20
Death rates in:						
HIC	0.04	0.08	0.05	0.09	0.64	0.22
LMIC	5.50	3.39	0.82	0.77	2.75	2.04
Rate ratio:	140.00	42.94	17.31	8.89	4.31	9.23

Source: The global burden of disease: 2004 update *(1)*.

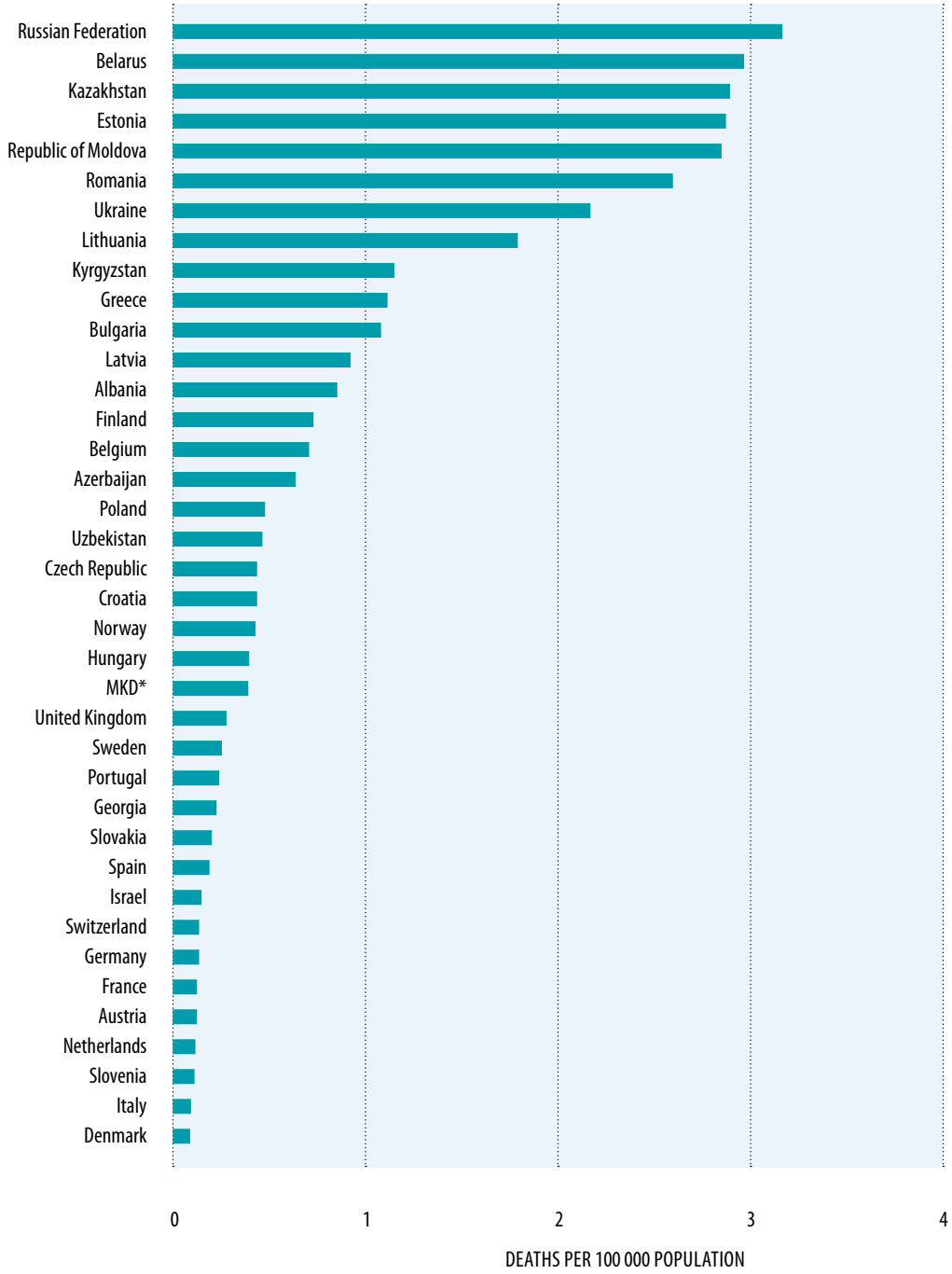
5.2.2 Morbidity

Although morbidity data for unintentional poisoning are not available at a regional level, data from individual countries shows that non-fatal poisoning is a serious concern to health services. A hospital-based study in the early 1970s from the United Kingdom reported an incidence of 340 per 100 000 for suspected poisoning and an actual poisoning incidence of about 115 per 100 000 in children under 15 years. As elsewhere, rates were highest in children under 5 *(5)*.

Thanks to the introduction of child-resistant container closures, the establishment of poison control centres and other safety measures, visits to hospital emergency departments for suspected poisoning have decreased significantly in Europe, in common with experience in the United States *(6)*. For example, in Oslo, Norway, incidence declined from 230 per 100 000 in 1980 to 97 per 100 000 in 2004 *(7)*. In contrast, incidence in Trieste, Italy rose from 155 per 100 000 in 1975–1979 to 352 per 100 000 in 1990–1994, although with a halving of hospital admission rates; this suggests that the increase was partly due to changes in referral and hospital utilization practices *(8)*.

Figure 5.1

Average standardized mortality rate for poisoning in children aged 0–19 in the WHO European Region, for 2003–2005 or most recent three years



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: European detailed mortality database (DMDB) [online database] *(4)*.

5.2.3 Costs

Data from the United States confirm that poisoning and its management are costly *(9)*. Figures from 2000 show 219 000 poisonings in children under 15 years, 141 of which were fatal; 14 000 victims were hospitalized and 205 000 were not. The lifetime cost of poisonings to children of this age was almost US$ 400 million, with medical treatment accounting for nearly 9%. This yields a conservative estimate of US$ 1780 for total costs per poisoning: medical, lost earnings and quality of life. Such costing studies are still to be undertaken in Europe *(10)*.

5.3 Risk factors

The prevalence and types of poisoning vary depending on socioeconomic status, cultural practices, industrial development and agricultural activities in different parts of the Region. Globally, a range of poisons has been implicated *(2)*. The home is the most common setting for childhood poisoning, and children are particularly at risk when harmful substances are stored in non-child-resistant containers or in easy reach. Unfortunately, information is often lacking on the nature of poisons and circumstances in which they were consumed.

5.3.1 Age and gender

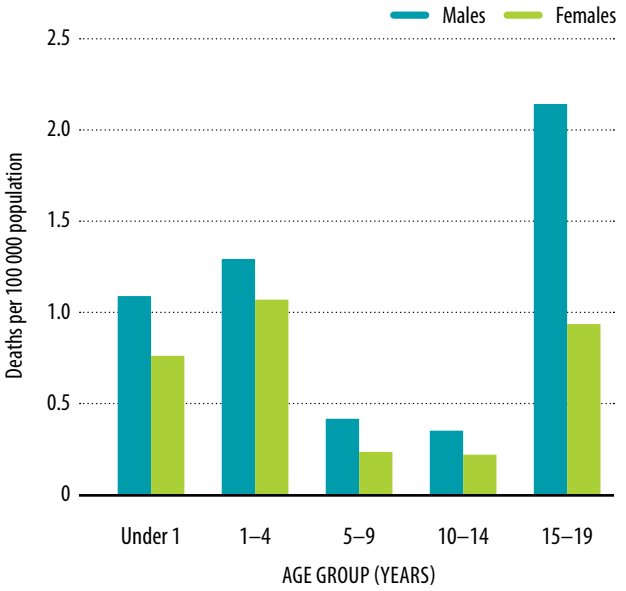
Age is an important factor because it influences children's behaviour and exposure and their susceptibility. Infants and toddlers are close to the ground and may swallow toxic substances placed there, such as rat poison. Young children are susceptible to liquid poisons, as they are orally oriented, inquisitive and unaware of poisons' toxic nature, and so would easily ingest inappropriately stored chemicals such as bleaches. Children's small body mass in relation to toxic dose and the physiological development of neutralizing enzymes makes them particularly susceptible.

Acute poisoning from alcohol partly explains the steep rise in mortality in the Region seen in males over 15 years old *(11)*. Further, the misuse of alcohol, medicaments or illicit drugs may compound poisoning in older children, leading to higher fatality *(7,12)*.

Poisoning has a higher prevalence in males than females at all ages but this difference is more pronounced in older children (Fig. 5.2). As with other injuries, these findings can be explained by gender differences in socialization and the fact that boys are more likely to engage in risky behaviour *(13)*.

Death rates from poisoning are higher in males than females at all ages, but particularly in the group aged 15–19 years. Overall, rates in males are 1.6 times those in females. The age groups with the highest mortality rates are boys aged 15–19 years and girls aged 1–4.

Figure 5.2
Age- and gender-specific mortality rates for poisoning in children in the WHO European Region, 2003–2005 or last available three years



Source: The global burden of disease: 2004 update *(1)*.

5.3.2 Poisonous agents

Information from selected poison control centres and hospitals indicates that the most common agents involved are:

- pharmaceuticals;
- household products such as bleach, disinfectants, detergents, cleaning agents, cosmetics, vinegar;
- pesticides including insecticides, rodenticides and herbicides; and
- various poisonous plants, and animal or insect bites *(7,14–16)*.

Most of children's exposure occurs in or around homes, where these agents are kept. In some parts of the Region, children working in agriculture are exposed to pesticides. Pesticides containing organophosphates and carbamates are particularly toxic, although their availability is often controlled, especially in HICs *(17)*. Some households in the Region still use paraffin or kerosene for heating and cooking, and exposure to these can lead to poisoning.

Factors influencing outcomes include not only the toxicity of the chemical but also its dose and type, the route of exposure and speed of remedial action. Carbon monoxide poisoning is a problem associated with the burning of hydrocarbon fuels, which may be more prevalent in winter. In some countries, such as Estonia, this is a leading cause of fatal poisoning *(18)*. Acute alcohol poisoning in older teenagers, and increasingly in younger age groups, is a concern in many parts of the Region, in both in HICs and LMICs, such as the Russian Federation and Belarus *(19,20)*. For example, it was reported as the leading cause of poisoning in 10–15-year-olds in the Trieste region, Italy: implicated in 30–40% of cases *(8)*. While pharmaceuticals, household

products and plants or mushrooms were a leading cause of poisoning in children under 8 years in Norway (39%, 32%, 16%, respectively), alcohol (46%) and pharmaceuticals (36%) were the leading causes in older children *(7)*. Other reports confirm this, and the increasing trend in teenagers' binge drinking is a growing cause of concern. In HICs, the substances associated with the greatest risk of death to children include medications available at home, such as anticonvulsant drugs, antidepressant drugs and iron supplements *(21)*.

5.3.3 Socioeconomic determinants and association with poverty

Poisoning deaths vary between and within countries; these patterns reflect socioeconomic differences *(11,22)*. Some countries have strong legislative and regulatory practices to control the availability and storage of toxic substances, while those undergoing transition do not yet have the infrastructure to oversee such governance, thus allowing the manufacture and wider availability of toxic substances. In the United Kingdom, for example, the availability of barbiturates and aspirin is now less wide spread and the distribution of the most toxic pesticides is strictly regulated *(14)*. The full advantages of such regulatory practices are yet to be realized in many countries. The evidence suggests that acute alcohol poisoning contributes to 70% of premature poisoning deaths in older teenagers in some of the CIS and Baltic countries, with binge drinking a cause for concern, as mentioned earlier *(10,19,23)*.

Socioeconomic status is a strong risk factor for poisoning in children as it affects exposure, is associated with several other risk factors and is a determinant for outcome. It influences the type of chemicals stored, whether they are safely stored, the containers they are sold in, the availability of adults for supervision, especially in single-parent families, and access to essential services such as poison control centres and emergency medical care *(24)*. For example, children in rural communities in some parts of the Region are more likely to be exposed to pesticides and kerosene, but have less access to modern poison control services. Poor nutritional status adversely influences outcome after poisoning, and the rural poor may be more likely to search for food alternatives, such as mushrooms, in some parts of the Region.

Deprivation is associated with both death and illness from poisoning *(25,26)*. Studies from the United Kingdom indicate that children from deprived backgrounds have three times the risk of dying from poisoning of those in affluent areas *(27)*. Differential admission rates have been reported by social class and for both medicinal and non-medicinal agents; in the most deprived groups these were 2.5 times and 2 times greater than in the least deprived groups *(28)*. This differential risk was highest for psychotropic drugs and organic solvents. Another study from the United Kingdom documented rate ratios for hospitalized children from the most deprived electoral wards; these were three times the rates for the least deprived *(29)*. In Finland, children from families in lower social classes are more likely to have more severe poisoning and delay seeking medical attention *(30)*. A study from Stockholm county showed that there was clustering of poisonings in children aged under 15 in communities of lowest socioeconomic status compared with the highest socioeconomic status. Many of these communities also had immigrant populations in financially precarious positions *(31)*. A study from Greece showed that the presence of both parents in the household was an important protective factor *(32)*.

5.3.4 Characteristics of the agent

The concentration or the potency of a toxic substance strongly influences its toxicity, and hence outcomes *(2)*. A higher incidence of poisoning is associated with liquid preparations than solid ones *(3)*. Liquids are easier to ingest, are generally absorbed faster and more liquid medications may be stored in households with children. Clear liquids are more attractive to children.

5.3.5 Storage of chemicals

Storing chemicals out of children's reach is important. Reported levels of safe poison storage range from 14% to 40%; unsafe places for storing medications include handbags, refrigerators and bathroom shelves *(33,34)*. Similarly, storing chemicals in inappropriate containers, such as drink bottles, carries risk because children may drink the contents.

Distinctive and properly labelled containers are only effective if adults follow the instructions to keep poisons out of reach. Many countries have legislation on storing toxic substances in child-resistant containers. Such containers are not always child proof, however, and safe storage out of children's reach and proper supervision by adults are necessary to eliminate risk. Overcrowded dwellings with limited storage facilities may thus be particularly hazardous *(35)*.

5.3.6 Seasonal variation

The availability, storage and exposure to chemicals show seasonal variations. Most children are out and about in summer, putting them at greater risk of potential exposure to, for example, pesticides and poisonous plants; in winter, they may be exposed to medications for coughs and colds *(2,36)*. Snakebites are also seasonal; most occur in the spring and summer months, as demonstrated in Croatia *(37)*.

5.4 Prevention

Estimates suggest that uniform implementation of safety measures in the Region could prevent about 93% of poisoning deaths, saving 2040 lives per year (Table 8.3). A better understanding of the risks and patterns of poisoning assists in developing strategies to reduce risks of unintentional poisoning *(15)*. Beyond the common call for continuous supervision, these strategies include environmental and behaviour modification through engineering, legislation and education *(38)*.

5.4.1 Environmental modification

As most childhood poisoning occurs in or around the home, modifying the environment, to limit access to poisons and confer passive protection, would be sensible. Approaches such as replacing toxic medications with less toxic ones – for example, barbiturates with benzodiazepines and aspirin and nonsteroidal anti-inflammatory drugs with paracetamol – is an effective strategy. This was associated with a decrease in poisoning from the more toxic compounds, and thus in deaths, in the United Kingdom *(14)*. Similarly, reducing the availability of potentially lethal herbicides has reduced deaths *(39)*. Less dependence on kerosene for heating and lighting reduces poisoning from this agent in children. Another approach is to colour such hydrocarbons blue, and store them in dark containers, thereby making them less attractive to children *(13)*. Ensuring that potentially toxic products are not transported, stored or sold in containers that children associate with beverages is crucial *(40)*. Eliminating the use of organophosphates and carbamates and using safer pesticides and more organic agricultural techniques have reduced the availability of and demand for more toxic herbicides, with a reduction in fatal poisonings *(17,39)*.

5.4.2 Engineering approaches

Using child-resistant closures is among the most successful strategies and a legislative requirement in many countries. For example, the 80% fall in poisoning deaths in children under 10 years old in England and Wales in 1968–2000 (from 20.6 per million to 4.5 per million) was largely attributed to the use of child-resistant closures *(14)*. Similar success stories have been reported elsewhere *(8,11,41,42)*. They have been successfully introduced in many countries through a combination of surveillance, advocacy, legislation and enforcement (Box 5.2). Safe storage in the home requires a secure location, to ensure that children cannot overcome barriers such as locks or height. This strategy may delay children's access to poisons. Children often gain access to poisons when they are in use, out of safe storage and without the child-resistant closure; this re-emphasizes the importance of supervisory vigilance.

BOX 5.2

Child-resistant packaging for chemicals, the Netherlands

In the Netherlands, as elsewhere, children under 5 years suffered a relatively high number of unintentional poisonings by household chemicals and pharmaceuticals, resulting in a large number of hospital admissions. A programme was set up to tackle this problem and legislation sought to make child-resistant packaging compulsory for household chemicals and pharmaceuticals.

The programme started in 1981, targeting the 1 million children in the Netherlands under 5 years of age. It requires partnership between the Ministry of Health, Welfare and Sport, the Consumer Safety Institute, the National Poison Information Centre and manufacturers.

Surveillance data on poisoning collected by the Institute were used to advocate legislation. In response, the Ministry called for child-resistant packaging of certain hazardous substances as part of the commodities act. The process included consultations with manufacturers and other stakeholders.

Products are tested for child-resistant closures by laboratory facilities established by the Inspectorate for Commodities. The range of substances has been extended in response to the changing pattern of poisoning and new chemicals.

A 1988 evaluation showed a decrease of 50% in hospital admissions for poisoning, due to these measures. Educational campaigns in the 1990s resulted in similar decreases. The Netherlands now has one of the lowest poisoning rates in the European Region.

Source: European Consumer Safety Association *(43)*.

5.4.3 Legislative approaches

A comprehensive poisoning prevention strategy must include legislative support, with enforcement, to ensure implementation and compliance, as shown by the introduction of child-resistant closures. EU countries have adopted legislation mandating the storage of toxic chemicals in child-resistant containers that are clearly and appropriately labelled, in places that are not within reach of children or near to foodstuffs and in such a way that they cannot be mistaken for food *(44)*. This clearly places the onus of protecting children from toxic substances on manufacturers and distributors, not solely on households. Such legislation has contributed to the lower rates of child poisoning seen in HICs in Europe, and this approach should be spread to the LMICs that do not have it. Measures to reduce alcohol poisoning include legislative and fiscal policy to reduce teenagers' access to alcohol and interventions to reduce binge drinking, particularly by teenage boys but increasingly also by girls *(11,45,46)*.

Globalization and the large volumes of merchandise that cross borders daily may make children vulnerable to poisonous substances through defective or improper manufacturing. The recent tragic incident of milk products tainted with melamine, although worst in China, threatened

to affect European children, resulting in the withdrawal of certain products by countries *(47)*. International standards and legislation need to be strengthened to regulate global companies, which can operate with insufficient levels of care. For example, the absence of legislation, regulations, guidelines and policies for the manufacture, storage, distribution and disposal of many products and byproducts, or lack of enforcement, has contributed to deaths due to contaminated medicines and toothpaste *(3)*.

5.4.4 Educational approaches

Education on poisoning prevention is useful within a wider programme of other interventions. Programmes such as home visitation to reinforce educational messages have been shown to be effective, especially when accompanied by practical and empowering solutions *(48,49)*. Home safety education and the provision of safety materials improve safety practices across diverse socioeconomic groups *(49)*. The effectiveness of education alone is dubious *(50)*.

Day care for preschool children is generally beneficial for child development *(51)* and attempts have been made to reduce social differentials and target deprived populations with schemes such as Sure Start in the United Kingdom. Safety measures are partially implemented in homes; while parental education on the need for consistent approaches is important, requiring the use of environmental measures – such as child-resistant containers, lockable medicine cupboards and warning labels – through legislation and regulatory controls is essential *(52)*.

Other targeted educational interventions have proved to be effective. For example, in Poland, where picking and eating wild mushrooms are both very popular during summer and consistently associated with a few deaths every year, a community-based multi-method programme to prevent mushroom poisoning for young schoolchildren was implemented in the Krakow region. Evaluation showed significant improvements in knowledge and decreased intention to eat wild mushrooms when unsure of their origin and edibility *(53)*.

5.4.5 Poison control centres and health care

After children have ingested poisons, early and accurate diagnosis can reduce the risk of illness and death. Parents or carers must seek advice from a poison control centre or health professionals. These centres can provide information to both the community and health care professionals to help them take appropriate and timely remedial action.

The development of poison centres that offer toxicological laboratory and scientific expertise is of proven benefit (Box 5.3). They have been shown to be effective in the United States, resulting in a 24% reduction in medically treated non-hospitalized cases and a 12% reduction in hospitalized cases *(6)*. When health service costs alone are considered, every dollar spent on poison control services was estimated to save US$ 6.50. The savings come from providing timely advice to carers and health facilities, resulting in a reduction in severe outcomes, and unnecessary use of more expensive health care services. The centres are able to direct first aid where appropriate, and refer more severe cases to a health facility. Harnessing the benefits of globalization, the centres use Internet to supply information to health care providers in emergency departments. This alternative to the traditional telephone-based query system can provide clinically relevant, up-to-date information at the point of delivery of patient care *(54)*.

Decontamination with the ingestion of activated charcoal remains the mainstay of treatment for serious poisoning, and has maximal efficacy if administered within two hours of ingestion *(21)*. The time from exposure to poison to the appearance of clinical features is an important influence on outcomes, and provides a window of opportunity to minimize absorption by removing or neutralizing the poison (in the case of ingestion) or to administer specific agents that prevent organ damage. Other means – such as the administration of emetic and cathartic agents – need to be evaluated on a case-by-case basis. Many sophisticated treatments and antidotes are tailored to various toxic substances, and poison control centres can provide invaluable support to front-line health professionals dealing with acute poisoning. Experience suggests that early, improved management of acute poisoning is important in reducing mortality and morbidity. A case has also been made for building health professionals' capacity to recognize and manage poisoning, and for developing guidelines for appropriate treatment *(17)*.

Table 5.2 summarizes key preventive strategies.

BOX 5.3

Work of the national poison centre in Portugal

The national poison centre (CIAV – Centro de Informação Anti-Venenos) is the medical centre providing poisoning information to health care professionals and the general public in Portugal. Set up in 1982, it works side by side with pre-hospital emergency care service, and serves a population of about 11 million people through a telephone helpline. The service is available 24 hours a day, 7 days a week and consists of physicians responding to enquiries. Questions are related to acute and chronic poisoning, the side effects of drugs and carcinogenic, mutagenic and teratogenic agents. CIAV receives about 30 000 calls per year; 50% come from health care professionals seeking advice about appropriate management. CIAV also takes part in building professionals' capacity in clinical toxicology, and takes part in primary and secondary prevention activities.

Most of child poisoning incidents occur at home, and a major part of calls received at the Centre occur in the early stages of the poisoning process. This has enabled a significant reduction in morbidity and mortality through the early taking of remedial action, and has contributed to a reduction in hospital attendance/admissions of children by parents concerned about false alarms.

Source: Centro de Informação Anti-Venenos [web site]. Lisbon, Instituto Nacional de Emergência Médica, 2008 (http://www.inem.pt, accessed 14 November 2008).

Table 5.2
Key strategies to prevent poisoning in children

Strategy	Effective	Promising	Insufficient evidence	Ineffective
Removing the toxic agent	✖			
Passing and enforcing legislation requiring child-resistant packaging of medicines and poisons	✖			
Packaging drugs in non-lethal quantities	✖			
Establishing poison control centres	✖			
Locking away medicines and other toxic substances		✖		
Removing or regulating availability of toxic substances that are easily mistaken for edible items			✖	
Teaching children to avoid poisonous substances			✖	
Reducing the attractiveness of medications and poisonous products			✖	
Providing home safety education and safety equipment			✖	
Clearly labelling toxic products				✖

Source: Peden et al. *(3)*.

5.4 Conclusions

Poisoning remains a leading cause of preventable childhood death and morbidity, and shows inequalities between and within countries in the European Region. Measures to reduce deaths include: requiring the use of child-resistant closures, providing education combined with home visitation, requiring the safe storage and restricting the availability of dangerous substances, and having a network of poison control centres.

Obstacles remain to further reducing poisoning incidence and morbidity in the Region. Steps that need to be taken include improving the availability of reliable data, improving the evaluation of interventions in diverse settings and confronting the lack of policy priority given to poisoning and the consequent lack of legislative and regulatory action (Box 5.4)

BOX 5.4

Key messages for policy-makers

- Better information is needed on poisonous agents and poisonings with disaggregation by social class.
- National plans for poisoning prevention are needed that include the use of child-resistant closures across the Region.
- Targeted action should be taken to reduce acute alcohol poisoning in children.
- Equitable access is needed to poison control centres and high-quality emergency medical care, with capacity building and guidelines to ensure consistent high standards.

5.5 References

1. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
2. Baker SP et al., eds. *The injury fact book*, 2nd ed. Lexington, Lexington Books, 1992.
3. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization (in press).
4. European detailed mortality database (DMDB) [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 13 November 2008).
5. Calnan M et al. Suspected poisoning in children. Study of incidence of true poisoning and poisoning scare in a defined population in North East Bristol. *Archives of Disease in Childhood*, 1976, 51:180–185.
6. Miller T, Lestina D. Costs of poisoning in the United States and savings from poison control centers: a cost benefit analysis. *Annals of Emergency Medicine*, 1997, 29:239–245.
7. Rajka T et al. Acute child poisonings in Oslo: a 2-year prospective study. *Acta Paediatrica*, 2007, 96:1355–1359.
8. Marchi A et al. Childhood poisoning: a population study in Trieste, Italy, 1975–1994. *Journal of Clinical Epidemiology*, 1998, 51:687–695.
9. Finkelstein E et al. *The incidence and economic burden of injuries in the United States*. New York: Oxford University Press, 2006.
10. Sethi D et al. *Injuries and violence in Europe: why they matter and what can be done*. Copenhagen, WHO Regional Office for Europe, 2006 (http://www.euro.who.int/document/E88037.pdf, accessed 28 October 2008).
11. Sethi D et al. Reducing inequalities from injuries in Europe. *Lancet*, 2006, 368:2243–50.
12. Cheng T et al. The spectrum of intoxication and poisoning among adolescents: surveillance in an urban population. *Injury Prevention*, 2006, 12:129–132.
13. Barss P et al. *Injury prevention: an international perspective. Epidemiology, surveillance, and policy*. London, Oxford University Press, 1998.
14. Flanagan R et al. Fatal childhood poisoning in childhood, England and Wales, 1968–2000. *Forensic Science International*, 2005, 148:121–129.

15. Bateman D. The epidemiology of poisoning. *Medicine*, 2007, 35:537–539.
16. Villa A, Cochet A, Guyodo G. Poison episodes reported to French poison control centres in 2006. *La Revue du Praticien*, 2008, 58:825–831.
17. Eddleston M et al. Pesticide poisoning in the developing world – a minimum pesticides list. *Lancet*, 2002, 360:1163–1167.
18. Vali M et al. Childhood deaths from external causes in Estonia, 2001–2005. *BMC Public Health*, 2007, 7:158.
19. European Health for All database [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://data.euro.who.int/hfadb, accessed 14 November 2008).
20. *Heath and health behaviour among young people*. Copenhagen, WHO Regional Office for Europe, 2000 (http://www.euro.who.int/Document/e82923.pdf, accessed 14 November 2008).
21. Shannon M. Ingestion of toxic substances in children. *New England Journal of Medicine*, 2000, 342:186–191.
22. Ahmed N, Andersson R. Unintentional injury mortality and socio-economic development among 15–44-year-olds: in a health transition perspective. *Public Health*, 2000, 114:416–422.
23. *Mortality among the population of the Russian Federation 2002*. Moscow, Ministry of Health of the Russian federation, 2003.
24. Basavaraj D, Forster D. Accidental poisoning in young children. *Journal of Epidemiology and Community Health*, 1982, 36:31–34.
25. Cubbin C et al. Socioeconomic status and the occurrence of fatal and nonfatal injury in the United States. *American Journal of Public Health*, 2000, 90:70–77.
26. Lyons R et al. Socioeconomic variation in injury in children and older people: a population based study. *Injury Prevention*, 2003, 9.
27. Roberts I. Cause specific social class mortality differentials for child injury and poisoning in England and Wales. *Journal of Epidemiology and Community Health*, 1997, 51:334–335.
28. Groom L et al. 2006 Inequalities in hospital admission rates for unintentional poisoning in young children. *Inj Prev*. 2006 Jun;12:166-70
29. Hippisley-Cox J et al. Cross sectional survey of socio-economic variations in severity and mechanism of childhood injuries in Trent 1992–7. *BMJ*, 2002, 324:1132–1138.
30. Eskola J, Poikolainen K. The frequency of children's poisonings in different social groups. *Human Toxicology*, 1983, 2:305–309.
31. Reimers A, Laflamme L. Neighbourhood social and socio-economic composition and injury risks. *Acta Paediatrica*, 2005, 94:1488–1494.
32. Petridou E et al. Risk factors for childhood poisoning: a case-control study in Greece. *Injury Prevention*, 1996, 2:208–211.
33. Wiseman H et al. Accidental poisoning in children: a multicentre survey. 2. The role of packaging in accidents involving medications. *Human Toxicology*, 1987, 6:303–314.
34. Jacobsen D et al. Acute poisoning of children in Oslo. A one year prospective study. *Acta Paediatrica Scandinavica*, 1983, 72:553–557.
35. Ozanne-Smith J et al. Childhood poisoning: access and prevention. *Journal of Paediatrics and Child Health*, 2001, 37:262–265.
36. Vichova P, Jahodar L. Plant poisoning in children in the Czech Republic, 1996–2001. *Human & Experimental Toxicology*, 2003, 22:467–472.
37. Luksić B et al. Venomous snakebites in southern Croatia. *Collegium Antropologicum*, 2006, 30:191–197.
38. *Best practices. Poisoning interventions*. Seattle, Harborview Injury Prevention Research Centre, 2008 (http://depts.washington.edu/hiprc/practices/topic/poisoning/packaging.html, accessed 06 April 2008).
39. Eddleston M. Influence of pesticide regulation on acute poisoning deaths in Sri Lanka. *Bulletin World Health Organization*, 2003, 81:789–798.
40. Krug A et al. The impact of child-resistant containers on the incidence of paraffin (kerosene) ingestion in children. *S Afr Med J*. 1994, 84:730-734
41. Rodgers G. The safety effects of child resistant packaging for oral prescription drugs: two decades of experience. *Journal of the American Medical Association*, 1996, 275:1661–1665.
42. Towner E et al. *What works for preventing unintentional injuries in children and young adolescents? An updated systematic review*. London, Health Development Agency, 2001.
43. *Child-resistant packaging for chemicals*. Amsterdam, European Consumer Safety Association, 2005.
44. *Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations*. Brussels, Office for Official Publications of the European Communities, 2008 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0045:EN:NOT, accessed 14 November 2008).
45. Rehm J et al. Alcohol use. In: Ezzatti M et al., eds. *Comparative quantification of health risks. Global and regional burden of disease attributable to selected risk factors*. Geneva, World Health Organization, 2004:959–1108.
46. Room R et al. Alcohol and public health. *Lancet*, 2005, 365:519–530.
47. Chinese milk scandal seen as risk in Europe. *International Herald Tribune*, 26 September 2008 (http://www.iht.com/articles/2008/09/26/asia/26melamine.php, accessed 14 November 2008).
48. Elkan R et al. The effectiveness of domiciliary health visiting: a systematic review of international literature and a selective review of the British literature. *Health Technology Assessment*, 2000, 4:1–339.
49. Kendrick D et al. Effect of education and safety equipment on poisoning prevention practices and poisoning: systematic review, meta-analysis and meta-regression. *Archives of Disease in Childhood*, 2008, 93:599–608.
50. Nixon J et al. Community based programs to prevent poisoning in children 0–15 years. *Injury Prevention*, 2004, 10:43–46.
51. Zoritich B et al. Day care for pre-school children. *Cochrane Database of Sytematic Reviews*, 2000, 2:CD000564.
52. Gibbs L et al. Understanding parental motivators and barriers to uptake of child poison safety strategies: a qualitative study. *Injury Prevention*, 2005, 11:373–377.
53. Malinowska-Cieslik M, van den Borne B. Prevention of mushroom poisoning of children: effectiveness of a community-based school education programme. *Health Education Research*, 1998, 1:13–23.
54. Bateman D et al. Web based information on clinical toxicology for the United Kingdom: uptake and utilization of TOXBASE in 2000. *British Journal of Clinical Pharmacology*, 2002, 54:3–9.

> “By giving child injury prevention greater priority, Member States will join a global effort to reduce a leading cause of child mortality, and creating a safer and more just society for children in the European Region.”

CHAPTER 6
THERMAL INJURIES

6.1 Introduction

Children are regularly exposed to flames and hot water in daily life. Thermal injuries include house fires, contact burns and scalds. Fires are a leading cause of death from injuries at home in children, and such deaths are concentrated in the most deprived populations. Although scalds represent a smaller proportion of injury deaths, they are more common and cause considerable morbidity. They are among the most distressing and painful injuries a child can receive and may result in long-term disfigurement and disability, including extensive scarring. In particular, burns to the face resulting in disfigurement can lead to poor self-image in children and adolescents *(1)*.

Children are particularly vulnerable to thermal injuries. They may not realize the dangers and risks associated with hot liquids and surfaces, and flames. Because a child has thinner skin and slower withdrawal reflexes than an adult, contact burns may be deep and thus require prolonged treatment *(2)*. In some areas of the Region, open flames are used for cooking and heating; children helping their carers in cooking are exposed to fire and hot liquids.

This chapter defines a thermal injury as an injury to the skin and other organic tissue caused by thermal trauma. It occurs when some or all of the cells in the skin and other tissues are destroyed by hot liquids (scalds), hot solids (contact burns) or flames (flame burns). Other types of burn injuries include those to the skin and other body parts due to radiation, electricity, friction or chemicals.

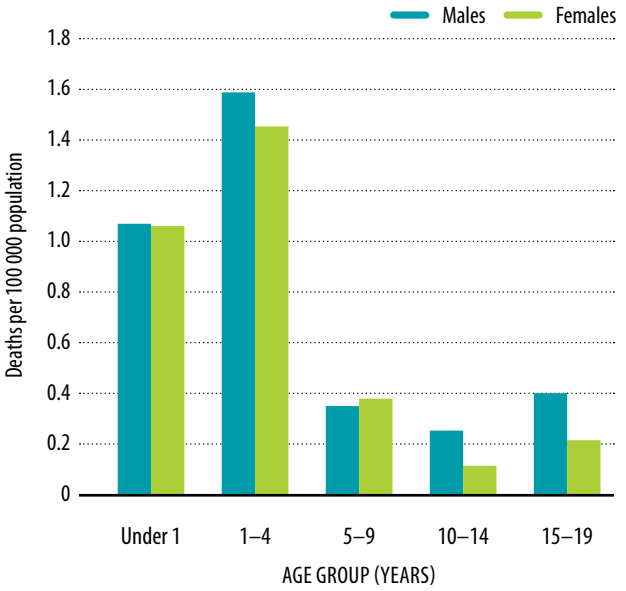
The WHO Regional Director for Europe, Dr Marc Danzon, summarized the human cost of such injuries; visiting Tajikistan after its health system was severely disrupted by a particularly long and harsh winter, he said, "But the worst was the eyes of the burnt patients in a specialized centre. You could see their desperation and the helplessness of parents as their children were crying with pain" *(3)*. Many of these children had been burned by make-shift heaters.

BOX 6.1

Key facts on thermal injuries

- Thermal injuries killed 1700 deaths children aged 0–19 years in the WHO European Region in 2004. Those that survive injury can be permanently scarred or disabled.
- Inequalities exist; the rate in the worst affected country is 85 times that in the country with the lowest rate. Within countries, the poorest are up to 38 times more vulnerable than the richest.
- If all countries matched the lowest rate in the Region, 9 out of 10 deaths could be averted.
- Many cost-effective strategies exist to prevent burns in children. A combination of approaches – involving legislation, engineering, environmental modification and education – needs to be implemented equitably across the Region.

Figure 6.1
Age- and gender-specific mortality rates from fires in children in the WHO European Region, 2003–2005 or most recent three years

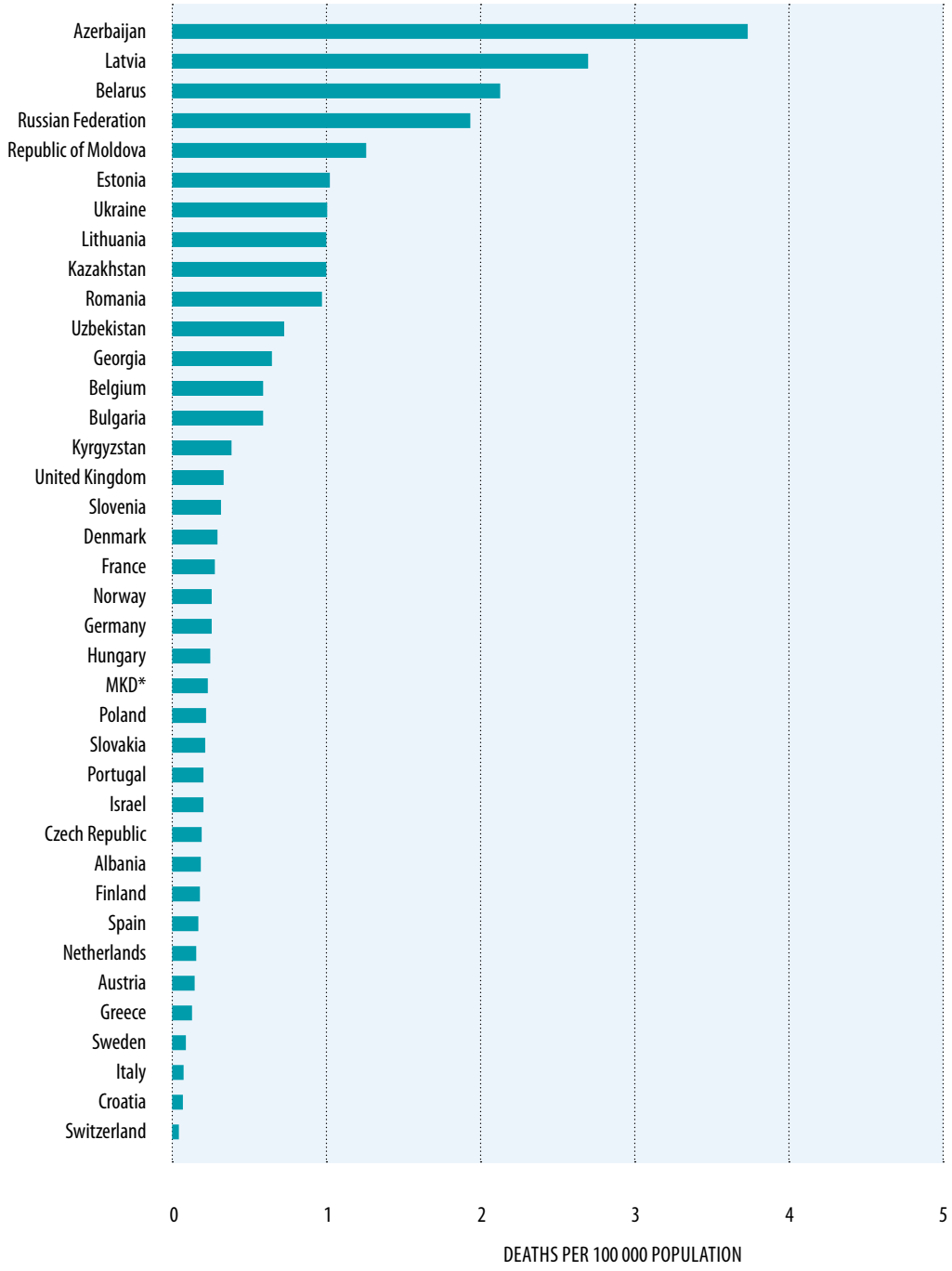


Source: The global burden of disease: 2004 update [web site] *(4)*.

6.2 Burden in the Region

Thermal injuries rank thirteenth among the leading causes of death to children aged 0–19 years in the WHO European Region. These injuries are estimated to have caused 1700 deaths in 2004: 4% of unintentional injury deaths *(4)*. The highest death rates appear to be in those under 5 years old (Fig. 6.1). Burns are the only injury that affects girls more in any age group of children: in children aged 5–9 years, rates are higher in girls than boys.

Figure 6.2
Standardized mortality rate from fires in children in the WHO European Region, 2003–2005 or most recent three years



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: European detailed mortality database (DMDB) [online database] *(5)*.

6.2.1 Mortality

The wide variations in mortality from thermal injuries reflect the geographical extent and diversity of the Region. The rates are highest in Azerbaijan, Latvia, Belarus and the Russian Federation and lowest in Switzerland, Croatia, Italy and Sweden (Fig. 6.2). The death rate in the country with the highest rate is 85 times that in the country with the lowest. Overall, some of these differences may be due to the differences in the attention given to safety, regulatory capacity, the quality of housing and public buildings, the use of carbon-based fuels and fires for heating and lighting, and the loss of social safety networks in some countries undergoing economic and political transition. Countries in proximity show some notable contrasts, such as Latvia, with a high injury rate, and Finland, with a low one.

6.2.2 Morbidity

Whether a child dies from a thermal injury, or the extent of scarring, depends on a number of factors, including the cause of the injury (fire versus hot water, for instance). The surface area burned, the depth of the skin burned, the body part burned and the age of the child all influence severity and outcome. In general, burns from house fires tend to be more fatal than those from scalds, due to not only the greater severity of the burn but also smoke inhalation, which can cause thermal or chemical damage to airways and lungs. The depth of a burn governs the thickness of scarring that develops, and the involvement of joints such as those of the hands may lead to the development of contractures that limit functioning.

In the European Region, children under the age of 5 years appear to be at the highest risk for hospital admissions for thermal injuries, although teenagers are also a high-risk group. Most thermal injuries in young children are due to hot liquid, including hot tap water or steam. The causes of non-fatal thermal injuries vary across the Region, as shown by the following examples.

- In Finland, a study conducted over 11 years showed that 42% of children admitted to paediatric burns units had suffered scalds; 100% of burns in the group under 3 years were the result of hot water. In the group aged 11–16, 50% of admissions were (unusually) due to electrical burns and 50% to fire and flames *(6)*.
- A study of thermal injuries in over 2000 children aged 10–14 in Bulgaria found that the most frequent cause (73%) was a hot liquid: 32% resulted from spilling hot liquids, 24% from falling on household containers of hot liquids and 14% from being splashed with hot water *(7)*. A further 13% of children were injured by flames. This kind of burn was most frequent in adolescents, and may relate to playing with matches, lighters or fire, and using fireworks. Electric burns were observed in 7% of children and contact burns in 6%. The burns usually occurred soon after the children learned to walk and began to touch hot objects such as irons and stoves. Chemical burns represented only 1% of all cases.
- In Israel, a study of children aged 0–14 admitted to hospital with a thermal injury, covering all five burns units in the country, was conducted between 1998 and 2004 *(8)*: 2705 children were admitted with thermal injuries, accounting for 51% of all burn admissions. Infants had the highest prevalence (45%). Scalds caused 68% of thermal injuries. Surgical intervention increased from 6% in 1998 to 21% in 2002.

6.2.3 Costs

Evaluating the cost of thermal injuries can be difficult, but burns pose a heavy economic burden on health services. Many non-fatal burns and scalds require costly procedures and prolonged hospital care. Complications such as infection can increase the length of stay, and result in disfigurement and severe disability.

A study from the United Kingdom investigated the financial costs of managing uncomplicated, minor paediatric scalds. Management in all cases involved a general anaesthetic for cleaning wounds, application of pharmaceuticals and dressings, observation on a children's ward and wound review before discharge. The calculated mean average cost per case was €1850 *(9)*. The cost of treating a severe scald in the United Kingdom has been estimated at €250 000 *(10)*. Additional costs to patients' families are associated with admission to hospital, the need for long-term rehabilitation, absence from school and possible future unemployment, social rejection and other psychosocial issues *(11)*.

6.3 Risk factors

6.3.1 Age

Children suffer different types of burns and scalds at different ages. Infants' lack of independent mobility means that they are likely to die in house fires even when others get out *(12)*. Scalds tend to be the most common type of burn in children under 5. In the middle of their first year, infants reach out to touch objects, so contact burns from hot objects or scalds from liquids, such as cups of tea or coffee, are common *(13)*. Children can burn the palms of their hands when touching heaters or hot-water pipes. As toddlers become more mobile, they encounter hot water, open fires, stoves and hot objects on tables, and may drink liquids that are dangerously hot. Preschool children may be burnt or scalded while imitating the daily tasks of caregivers, such as ironing or cooking.

As children age, they become less likely to be injured by common household objects and more interested in the world outside, increasing the likelihood of involvement in serious fires. In particular, boys aged over 6 years often become curious about fire, and experiment with matches, lighters or fireworks.

6.3.2 Gender

Thermal injuries appear to have a smaller gender difference than other injury types. In Turkey, for example, a study of children and adolescents aged 0–18 years admitted to hospital with burn injuries found similar rates of injuries in boys and girls (ratio of 0.98–1.0) *(14)*. Boys may be at greater risk of burns from fireworks than girls due to their more inquisitive nature and risky behaviour. The greater risk to girls of flame-related burns and scalds may be linked to exposure to hot objects while assisting their caregivers in the kitchen.

6.3.3 Environmental factors

Most childhood thermal injuries occur in the home, particularly in the kitchen, and are caused by commonly used items, such as saucepans, kettles, taps, stoves, hot beverages, irons and heaters *(15)*. In some homes, the location of heating equipment and the kitchen's structure may present significant risks to children. Some countries have particular environmental risks: in Turkey, for example, the tandir, an underground oven, is a significant cause of burns, particularly in children *(16)*.

In homes with very cramped living space, rooms can be used for different purposes, depending on the time of day and the families' needs: sleeping, washing, cooking or eating *(17)*. This can increase children's exposure to hot substances and objects. In addition, the interaction between housing conditions, socioeconomic barriers and levels of child dependency may affect childhood thermal injuries.

6.3.4 Tobacco and alcohol

Tobacco and alcohol use are implicated in deaths from house fires. Careless smoking is the most common cause of fatal house fires, and a number of deaths result from smoking while intoxicated.

Having a smoker in a household increases the risk of death in a house fire by up to 4.8 times, and impairment by alcohol or drugs, by 7.5 times *(18)*. Thus, children living in the homes of heavy smokers or drinkers are more at risk from house fires, and reducing both smoking and drinking would have the added public health benefit of reducing this risk *(19)*.

6.3.5 Supervision

Appropriate supervision is more important in hazardous environments, and can be difficult when, "care-givers are overburdened and torn between conflicting responsibilities" *(20)*. Single parenthood, large families, unsupported or depressed mothers or caregivers, and the lack of adequate child care facilities can increase the stresses of parenting *(21)*.

6.3.6 Socioeconomic determinants and association with poverty

Mortality and morbidity from thermal injuries is strongly associated with poverty. A meta-analysis of risk factors found that those in the lowest income quintiles were 2.4 times more likely to die in house fires than those in the highest two income quintiles *(18)*. A study from the United Kingdom showed that children from the lowest social class were 16 times more likely to die in fires than those from the highest social class *(22)*. This study was repeated a decade later, and the social-class gradient remained steep. Edwards et al. *(23)* found that the death rate for fires was 37.7 (11.6–121.9) times higher for children of parents classified as never having worked or long-term unemployed, compared with children in families from higher managerial/professional occupations.

Within countries, considerable variations by social class are reported for other burn injuries. For instance, studies from the Sweden and United Kingdom reported increased risk of burns among poorer children *(24,25)*. The relative risk of being hospitalized for a burn in Sweden was 2.3 times higher for children in the lowest socioeconomic group than in those in the highest. Further, the risk of burns was greater than that for any other childhood injury *(24)*.

6.3.7 Medical conditions and "outsider" status

Some children are more vulnerable to thermal injuries than others; for example, disabled children have a significantly higher incidence of thermal injuries *(26)*. Although not specific to children, those who suffer from uncontrolled epilepsy appear to be at greater risk for thermal injuries *(27)*.

Other vulnerable groups include the children of asylum seekers (28) and those living in HICs such as Denmark and Sweden but born to foreign parents *(29)*.

6.3.8 Fireworks

People use fireworks to celebrate religious and other festivals in many countries in the Region. Fireworks have been banned in some HICs, but still pose a significant risk for children, particularly adolescent boys. In Greece, for instance, 70% of burn injuries seen in emergency departments were in boys aged 10–14 years; boys' injuries were usually self-inflicted, while injured girls were usually bystanders *(30)*.

6.3.9 Ultraviolet radiation exposure through tourism

Tourism across frontiers in Europe has exposed increasing numbers of children to excessive ultraviolet radiation on summer and skiing holidays. About 130 million tourists travel from northern Europe to Mediterranean regions in summer, with 14 million people alone going to Greece each year, many of whom have "a high tendency to burn" *(31)*. The rapid change in environments can exacerbate this process.

Such exposure can lead to both acute events of sunburn and skin cancer later in life. Countries across the Region vary widely in their steps to reduce the excessive exposure of children to ultraviolet radiation *(32)*.

6.3.10 Fire disasters

Children and adults are at risk of death and serious injury in fire disasters. In Gothenburg, Sweden in 1998, such a disaster in an overcrowded discotheque killed 68 teenagers and injured 213. The large number of injuries concentrated in one community required psychosocial rehabilitation lasting for years *(33,34)*.

6.4 What can be done

In some parts of the European Region, great strides have been made in the prevention, management and long-term rehabilitation of thermal injuries.

If all countries matches the lowest death rate from fires in the Region (in Switzerland), 9 out of 10 deaths (1200 total) could be avoided (Table 8.3). Evidence points to three broad approaches to preventing thermal injuries in children – design and other engineering measures, legislation and standards and educational strategies. Approaches that combine a range of measures appear to have the most far-reaching effects.

6.4.1 Design and other engineering measures

The evidence of effectiveness for smoke alarms is good; they have been found to reduce the risk of death by more than 70% in the United States *(35)*. A systematic review of controlled trials of interventions to promote smoke alarms found only modest benefits from education-only approaches, but programmes that provided and installed smoke alarms appeared to reduce fire-related injuries *(36)*. Programmes that combined smoke-alarm legislation with installation and education, however, showed the greatest benefit *(37)*. The challenge is to find ways to ensure that all homes have working smoke alarms on all levels and in sleeping areas. The cost–effectiveness of smoke detectors has been evaluated in the United States. For every dollar spent on a detector, about US$ 26 is saved in health care costs *(38)*.

The effectiveness of fire sprinkler systems has been demonstrated and they are now widely found in public and commercial buildings in many countries *(39)*. Home sprinkler systems, on the other hand, are recommended but not widely used, and governments are beginning to require them in certain new homes. They may have a role in high-risk areas of older housing *(40)*.

Evidence indicates that regulating the temperature of water flowing from household taps is a promising means of preventing scalds *(41)*. Thermostatic mixer valves, recently developed for the domestic market and fitted across the hot- and cold-water supply pipes of the bath, allow delivery of water set at a fixed temperature from the hot bath tap. A trial of these valves is underway in Scotland, evaluating their effectiveness and cost–effectiveness in the homes of families with young children in social housing, families' satisfaction with them and the fitting process, and potential unintended adverse events *(42)*. In 2003, the French Consumer Safety Commission *(43)* adopted recommendations on new or renovated installations that restricted the temperature of domestic hot water to 50 °C at drawing points outside the kitchen. For existing installations, the Commission encouraged households, particularly those with young children, to install temperature-limiting devices, at least at bathroom drawing points, and owners and managers were asked to provide clear information.

Modifying products associated with fire-related burns also has promise *(44)*. Some evidence from New Zealand indicates that legislation controlling the design of and types of materials used in making children's sleepwear could reduce burn injuries *(45)*. The US Product Safety Commission requires that children's sleepwear pass a flammability test or be tight fitting to reduce the risk of burns *(46)*. In addition, many countries require that bedding, mattresses and upholstered furniture be of flame-retardant materials. In line with environmental health concerns, fire-retardant materials that pose less risk to children should be recommended.

6.4.2 Environmental modifications

A number of environment modifications hold promise to reduce thermal injuries: modification of building codes and standards and construction materials, improved heating and lighting equipment in homes, modification of cooking facilities and separation of cooking from living areas. Such prevention strategies have not been well evaluated, however. A Cochrane review concluded that the evidence was insufficient to determine the effectiveness of modification of the home environment to reduce injuries, including burns *(47)*.

A ban on the most hazardous grades of foam in furniture has reduced the amounts of toxic smoke produced in a house fire.

6.4.3 Legislative approaches

In the European Region, a number of EU laws and regulations have a direct impact on many countries. Policy-makers need to ensure that these are adopted and implemented in their countries. Laws and regulations are effective mechanisms to ensure that large segments of the population adopt safety behaviour. In addition to smoke-detector legislation (which has been effective in ensuring that smoke alarms are installed in new homes and has reduced burns from residential fires in many HICs), two other legislative interventions appear to have positive effects: legislation on hot-water taps and standards for child-resistant lighters.

The control of hot-water temperature in taps in Washington state, United States reduced domestic scalds through the combination of an educational programme and

legislation to pre-set water heaters at lower temperatures *(48)*. A study from Ontario, Canada, evaluated the effectiveness of a combined educational and legislative strategy to reduce thermostat settings, and found an estimated 56% reduction in scalds *(49)*.

The US Consumer Product Safety Commission developed a standard for cigarette lighters *(50)*, applicable to all lighters manufactured or imported in the country after July 1994. A post-implementation study found that fires, deaths, and injuries caused by young children playing with lighters had been reduced by as much as 58% *(51)*. In March 2007, the EU introduced a European standard for child-resistant lighters *(52)*. Self-extinguishing cigarettes have been developed, tested and found effective *(53)*.

Further, some European countries have legislation or regulations restricting children's access to fireworks. A multifaceted brief intervention to reduce firework injuries from Naples, Italy was implemented at New Year celebrations. This included both enforcing laws on the sale and use of fireworks and cleaning the streets to remove unexploded fireworks *(54)*.

6.4.4 Educational approaches

Educational programmes aimed at children in schools and communities include, for example, "Stop, Drop and Roll" and "Risk Watch". Knowledge gains among young children have been demonstrated for such programmes *(55)*, but whether they reduce burns is unclear, since they lack rigorous evaluation of long-term outcomes *(56)*.

In addition, community programmes to ensure adequate supervision and general well-being of children, educate parents about burns and advise the public against storing flammable substances in the home have been proposed as primary preventive strategies *(57)*. Anticipatory guidance on injury prevention has shown gains in parents' knowledge and satisfaction, but failed to demonstrate increases in the use of safety equipment *(58,59)*. Similarly, home-visitation programmes show ambivalent results that discourage their clear endorsement. Nevertheless, educational approaches underpin others, such as increasing access to specific safety products or changing the law.

6.4.5 First aid for thermal injuries

The objective of first aid is to cool a burn promptly with cold water, and prevent continued burning and contamination. Early cooling has been shown to prevent a significant percentage of superficial burns (32%) from progressing to deep burns. This reduces not only the probability that skin grafting and expensive treatment will be required but also the risk of other consequences of deep burns, which may be fatal *(60)*.

6.4.6 Management of burns

In general, if more than 30% of the surface area of a child's body is burnt, he or she has a 50% chance of dying. Specialist treatment in paediatric burn centres is recommended for serious burns covering more than 10% of surface area and involving vital body parts such as the face, groin and hands. This improves survival and decreases disfiguring and disabling scarring. Both physical and psychological rehabilitation may be required for a long time.

6.4.7 Intersectoral action

There are many stakeholders in preventing thermal injuries. In the national government, they include the ministries concerned with health, housing and consumer safety, which need to work closely with local government departments, fire-fighters, manufacturers, and NGOs to reduce the burden of thermal injuries. The health sector can advocate action by using surveillance data and help coordinate the delivery and evaluation of programmes.

6.5 Conclusions

Thermal injuries are a leading cause of death and disfigurement in children, showing great inequities between and within countries in the European Region. A variety of measures can prevent or control such injuries, including legislation and regulations, environmental modification, and education and awareness raising.

A gap remains, however, between what is known to work in prevention and how to make it work in the real world, where a range of community-based programmes can be implemented *(61)*. Much of the literature on effective interventions comes from HICs, and the needs of LMICs in the Region are a priority. Many stakeholders are involved in preventing thermal injuries: national and local government departments, legislators, fire-fighters, manufacturers, the housing sector and NGOs. A multifaceted approach, involving a range of stakeholders including community members, is likely to be most successful (Box 6.2).

BOX 6.2

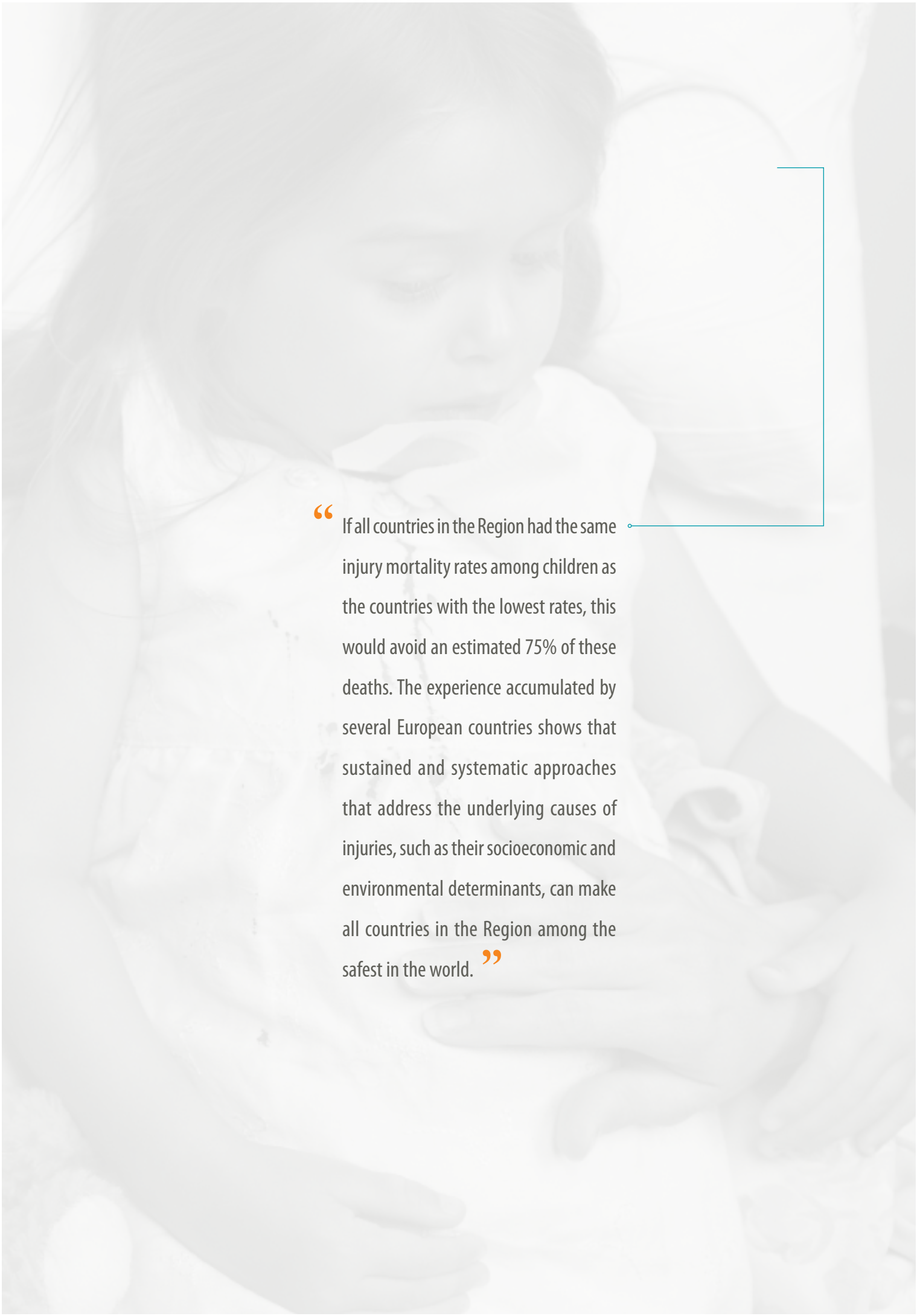
Messages for policy-makers

- Deaths and injuries resulting from thermal injuries are strongly linked to unsafe environments and products, especially in the home.
- Laws to enforce smoke-alarm installation, hot-water regulation and cigarette-lighter standards are effective in preventing thermal injuries and need wide implementation.
- First-aid initiatives and the provision of high-quality burn care ensure the best possible physical and psychological outcomes and need wide support.

6.6 References

1. Clarke A. Psychosocial aspects of facial disfigurement: problems, management and the role of a lay-led organization. *Psychology, Health & Medicine*, 1999, 4:127–142.
2. Argirova M, Hadzhiyski O. Treatment of palm burns in children. *Annals of Burns and Fire Disasters*, 2005, 18:190–193.
3. *WHO Regional Director for Europe visits Tajikistan*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/Tajikistan/20080226_1, accessed 17 November 2008).
4. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
5. European detailed mortality database (DMDB) [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 13 November 2008).
6. Papp A et al. Paediatric ICU burns in Finland 1994–2004. *Burns*, 2008, 34:339–344.
7. Hadjiiski O et al. Epidemiological survey of children's burns in Bulgaria and a burn prevention programme. *Annals of Burns and Fire Disasters*, 1999, 12.
8. Goldman S et al. Childhood burns in Israel: A 7-year epidemiological review. *Burns*, 2006, 32:467–472.
9. Griffiths H et al. The cost of a hot drink scald. *Burns*, 2006, 32,372–374.
10. *Consumer safety research: Burns and scalds in the home*. London, Department of Trade and Industry, 1999.
11. Joseph K et al. Parental correlates of unintentional burn injuries in infancy and childhood burns. *Burns*, 2002, 28:455–463.
12. Wilson M et al. *Saving children: a guide to injury prevention*. Oxford, Oxford University Press, 1991.
13. Nguyen D et al. Infants under 1 year of age have a significant risk of burn injury. *Burns*, 2008, 34:863–867.
14. Sakallıoğlu A et al. Burns in Turkish children and adolescents: nine years of experience. *Burns*, 2006, 33:46–51.
15. Turner C et al. Community-based interventions for the prevention of burns and scalds in children. Cochrane Database of Systematic Reviews 2004, Issue 2, updated 2006. Art. No.: CD004335. DOI: 10.1002/14651858.CD004335.pub2.
16. Bekerecioglu M et al. Tandir: an old and well known cause of burn injury in the Middle East. *Burns*, 1998, 24:654–657.
17. Seedat M et al. The application of still photography in marshalling data for community-based initiatives. *African Journal of Psychology*, 2006, 2:303–314.
18. Warda L et al. House fire prevention update. Part 1. A review of risk factors for fatal and non-fatal house fires. *Injury Prevention*, 1999, 5:145–150.
19. Towner E, Ward H. Prevention of injuries to children and young people: the way ahead for the UK. *Injury Prevention*, 1998, 4(4): S517-525
20. Bartlett S. The problem of children's injuries in low-income countries: a review. *Health Policy and Planning*, 2002, 17:1–13.
21. *A league table of child deaths by injury in rich nations*. Florence, UNICEF Innocenti Research Centre, 2001 (http://www.unicef-icdc.org/publications/pdf/repcard2e.pdf, accessed 17 November 2008).
22. Roberts I. Cause specific social class mortality differentials for child injury and poisoning in England and Wales. *Journal of Epidemiology and Community Health*, 1997, 51:334–335.
23. Edwards P et al. Deaths from injury in children and employment status in family: analysis of trends in class specific death rates. *BMJ*, 2006, 333:119–122.
24. Reimers A, Laflamme L. Neighbourhood social and socio-economic composition and injury risks. *Acta Paediatrica*, 2005, 94:1488–1494.
25. Hippisley-Cox J et al. Cross sectional survey of socio-economic variations in severity and mechanism of childhood injuries in Trent 1992–7. *BMJ*, 2002, 324:1132–1138.
26. Chen G et al. Incidence and pattern of burn injuries among children with disabilities. *Journal of Trauma*, 2007, 62:682–686.
27. Spitz M. Injuries and death as a consequence of seizures in people with epilepsy. *Epilepsia*, 1998, 39:904–907.
28. Dempsey M, Orr D. Are paediatric burns more common in asylum seekers? An analysis of paediatric burn admissions. *Burns*, 2006, 32:242–245.
29. Carlsson A et al. Burn injuries in small children, a population-based study in Sweden. *Journal of Clinical Nursing*, 2006, 15:129–134.
30. Vassilia K. Firework-related childhood injuries in Greece: a national problem. *Burns*, 2004, 30:151–153.
31. Argyriadou S et al. Knowledge and behaviour of tourists towards the sun, as studied in a region of northern Greece. *Rural and Remote Health*, 2005, 5:367.
32. European Environment and Health Information System (ENHIS). *Policies to reduce the excessive exposure of children to ultraviolet radiation*. Copenhagen, WHO Regional Office Europe, 2007 (Fact sheet No. 4.8).
33. Cassuto J. The discotheque fire in Gothenburg 1998. A tragedy among teenagers. *Burns*, 1998, 29:405–416.
34. Tarnow P et al. Fire disaster in Gothenburg 1998 – surgical treatment of burns. *Burns*, 2003, 29:417–421.
35. Runyan C et al. Risk factors for fatal residential fires. *New England Journal of Medicine*, 1992, 327:859–863.
36. DiGuiseppi C, Higgins J. Systematic review of controlled trials of interventions to promote smoke alarms. *Archives of Diseases in Children*, 2000, 82:341–348.
37. Ballesteros M et al. Working towards the elimination of residential fire deaths: the Centers for Disease Control and Prevention's smoke alarm installation and fire safety (SAIFE) program. *Journal of Burn Care and Rehabilitation*, 2005, 26:434–439.
38. *Working to prevent and control injury in the United States – Fact book for the year 2000*. Atlanta, National Center for Injury Prevention and Control, 2000.
39. *Home fire protection. Residential fire sprinkler systems [FA–43]*. Washington, DC, Federal Emergency Management Agency, 2004 (http://www.modestofire.com/Documents/Brochures/hfp-redsprinklers.pdf, accessed 17 November 2008).
40. Shai D. Income, housing, and fire injuries: a census tract analysis. *Public Health Reports*, 2006, 121:149–154.
41. MacArthur C. Evaluation of Safe Kids Week 2001: Prevention of Scald and Burn Injuries in Young Children. *Injury Prevention*, 2003, 9:112–116.
42. Kendrick D et al. Randomised controlled trial of thermostatic mixer valves in reducing bath hot tap water temperature in families with young children in social housing: A protocol. *Trials*, 2008, 9:14.
43. *Recommendation on the danger of burns presented by domestic hot water 10/03*. Paris, Consumer Safety Commission (http://www.securiteconso.org/notice53.html?id_article=53, accessed 17 November 2008).
44. Schieber R et al. Legislative and regulatory strategies to reduce childhood unintentional injuries. *The Future of Children*, 2000, 10:111–136.

45. Laing R, Bryant V. Prevention of burn injuries to children involving nightwear. *New Zealand Medical Journal*, 1991, 104:363–365.
46. U.S. Consumer Product Safety Commission, 2001. *Children's sleepwear regulations*. Washington DC, U.S. Consumer Product Safety Commission. Office of Compliance, 2001.
47. Lyons R et al. Socioeconomic variation in injury in children and older people: a population based study. *Injury Prevention*, 2003, 9.
48. Feldman K et al. Tap water scald burns in children. *Injury Prevention*, 1998, 4:238–242.
49. Han R, Ungar W, Macarthur C. Cost–effectiveness analysis of a proposed public health legislative/educational strategy to reduce tap water scald injuries in children. *Injury Prevention*, 2007, 13:248–253.
50. U.S. Consumer Product Safety Commission, 2005. Office of Compliance. Requirements for Cigarette Lighters, 16 C.F.R. Part1210. http://www.cpsc.gov/businfo/regsumlighters.pdf
51. Smith L et al. Study of the effectiveness of the US safety standard for child resistant cigarette lighters. *Injury Prevention*, 2002, 8:192–196.
52. EN 13869:2002EU web site. (http://ec.europa.eu/consumers/safety/prod_legis/prod_legislation_lighters_en.htm, accessed 14 November 2008)
53. MacKay M et al. *Child safety good practice guide: Good investments in unintentional child injury prevention and safety promotion*. Amsterdam: European Child Safety Alliance, Eurosafe, 2006.
54. D'Argenio P et al. Capodanno Senza Danno: the effects of an intervention program on fireworks injuries in Naples. *American Journal of Public Health*, 1996, 86:84–86.
55. Kendrick D et al. "Risk Watch": cluster randomized controlled trial evaluating an injury prevention program. *Injury Prevention*, 2007, 13:93–99.
56. Warda L, Ballesteros M. Interventions to prevent residential fire injury. In: Doll L et al., eds. *Handbook of injury and violence prevention*. Atlanta, Springer, 2007:97–115.
57. Forjuoh S, Guohua, L. A review of successful transport and home injury interventions to guide developing countries. *Social Science and Medicine*, 1996, 43(11):1551–1560.
58. Gielen AC et al. A randomized trial of enhanced anticipatory guidance for injury prevention. *Archives of Pediatric and Adolescent Medicine*, 2001, 155:42–49.
59. Gielen AC et al. The effects of improved access to safety counseling, products and home visits on parents' safety practices. *Archives of Pediatric and Adolescent Medicine*, 2002, 156:33–40.
60. Nguyen N et al. The importance of immediate cooling – a case series of childhood burns in Vietnam. *Burns*, 2002, 28:173–176.
61. Turner C et al. Community-based interventions for the prevention of burns and scalds in children. *Cochrane Database of Systematic Reviews*, 2004, updated 2006, CD004335.



> “If all countries in the Region had the same injury mortality rates among children as the countries with the lowest rates, this would avoid an estimated 75% of these deaths. The experience accumulated by several European countries shows that sustained and systematic approaches that address the underlying causes of injuries, such as their socioeconomic and environmental determinants, can make all countries in the Region among the safest in the world.”

WHY CHILDREN NEED SPECIAL ATTENTION

CHAPTER 7
FALLS

7.1 Introduction

Children learn by exploring their surrounding environments and, as they walk, run, climb and jump from place to place, they often fall. Most falls are not serious, and children continue on their way with a better understanding of what they can and cannot do. Falls from heights or onto hard surfaces, however, can result in serious injury, disability or death. Children are especially vulnerable, as they may not recognize the risks or correctly judge their physical and mental ability to carry out an activity safely.

Some countries in the WHO European Region have worked to prevent falls. Good practices – such as redesigning products for children, improving stair design and introducing and enforcing safe window design – have contributed to the reduction of children's injuries and fatalities from falls.

This chapter defines a fall as an event that results in a person coming to rest inadvertently on the ground or floor or other lower level *(1)* (Box 7.1). Injuries from falls are the result of the abrupt dissipation of mechanical energy. Three factors are important in the outcome:

- the amount of energy generated or released by the fall, with the severity of the injury sustained being governed largely by the height from which a child falls *(2)*;
- how much energy is transmitted, which depends on the object or surface the child falls onto (for example, a grassy surface absorbs more impact than concrete); and
- the points of energy transmission: if the forces of the fall are spread over a large part of the body, the chance of injury is reduced *(3)*.

BOX 7.1

Key facts for falls in the WHO European Region

- More than 1500 children aged 0–19 years die from falls in the Region each year.
- Falls are often the most common cause of fatal and serious head injuries to young children.
- Inequalities exist: children in the countries with the highest rates have 22 times the risk of death of those in the countries with the lowest rates. If all countries matched the lowest rate in the Region, 9 out of 10 deaths could be averted.
- Proven strategies to reduce serious falls in children include: modifying or replacing unsafe products, legislation requiring window guards, and implementing playground standards and multifaceted community programmes.

7.2 Burden in the Region

7.2.1 Mortality

More than 1500 people under 20 years of age die as a result of severe falls each year in the European Region: more than 4 deaths per day *(4)*. Falls rank as the fourth leading cause of injury death for this age group. While falls do not rank in the top 15 causes of death for children aged 0–14 years, they rank eighth as a leading cause of burden or DALYs lost (Table 2.3). Falls are an important source of disability because they are common and may have serious long-term health consequences.

Death rates for falls vary widely in the Region. Children in the countries with the highest mortality rates, the Russian Federation, Kyrgyzstan and Belarus, have 22 times the risk of dying from a fall of children in the countries with the lowest rates, Sweden, Netherlands and the United Kingdom (Fig. 7.1). Some of the possible explanations for such great differences include environment and housing conditions, regulation of child-related products and community and family attention to safety issues.

If all countries in the European Region matched the country with one of the lowest fall death rate in the Region (Sweden), 9 out of 10 deaths could be prevented, saving about 1400 lives each year (Table 8.3). Death rates in LMICs in the Region are three times those in HICs. Rates for infants are eight times higher in LMICs (Table 7.1).

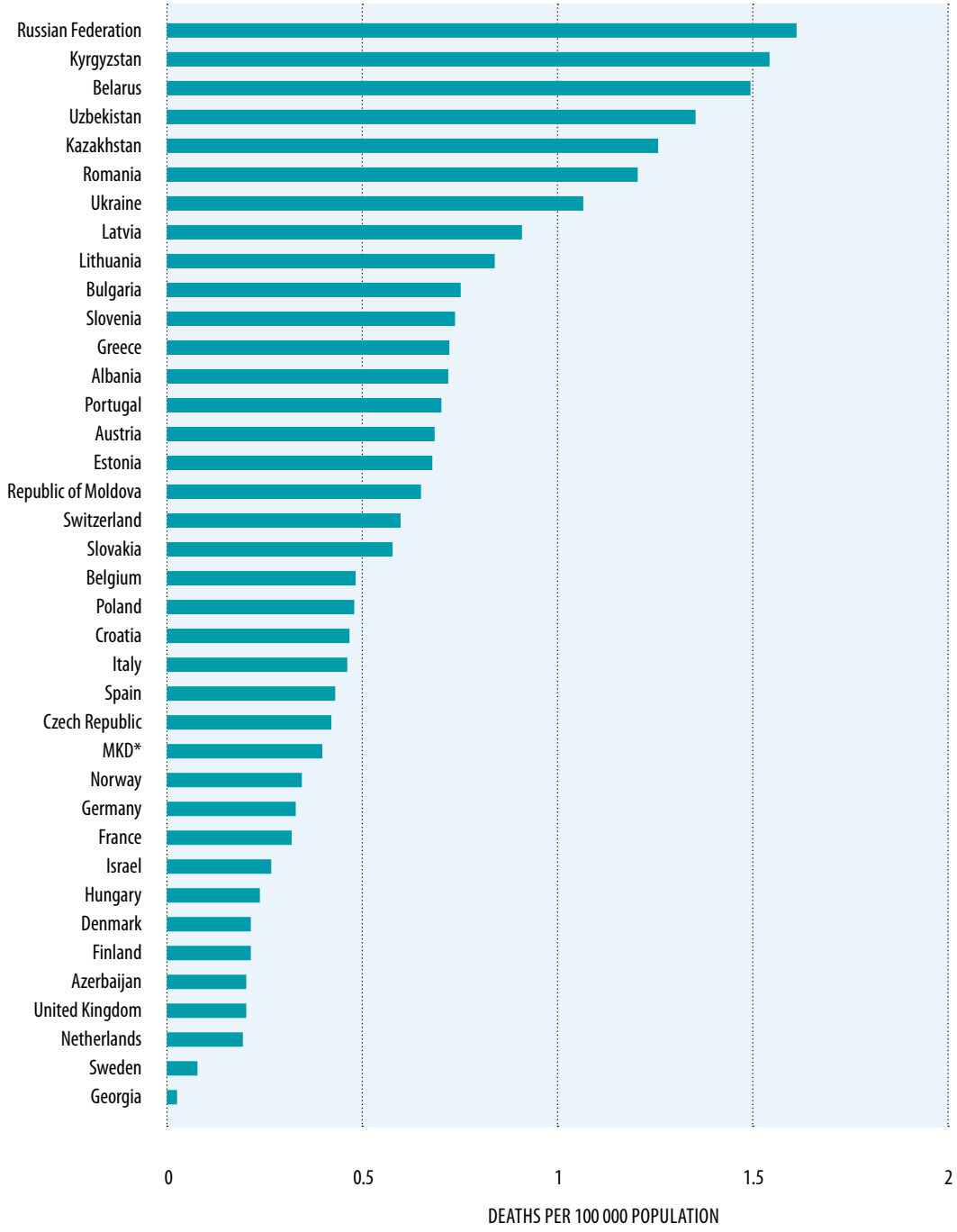
Table 7.1
Age-standardized death rates for falls by age group with rate ratios for LMICs and HICs in the European Region

	Age groups (years)					
	<1	1–4	5–9	10–14	15–19	<20
Death rates in:						
HIC	0.34	0.45	0.16	0.21	0.49	0.32
LMIC	2.92	1.68	0.62	0.72	0.81	0.98
Rate ratio:	8.52	3.75	4.00	3.47	1.65	3.06

Source: The global burden of disease: 2004 update [web site] *(4)*.

Figure 7.1

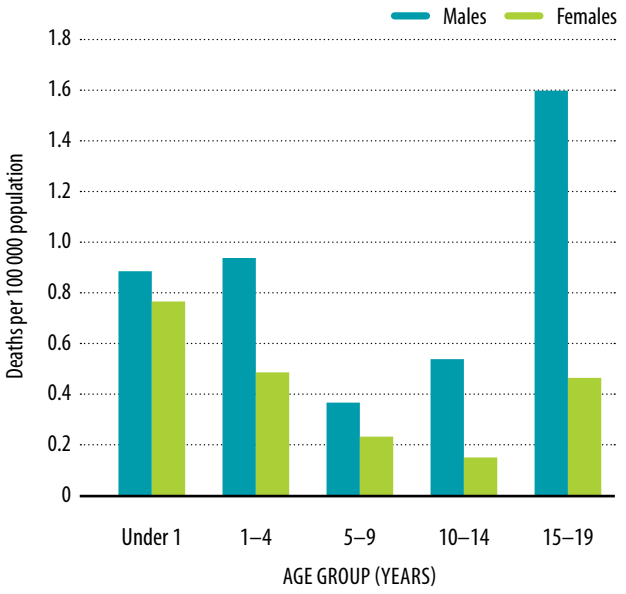
Average standardized mortality rates for falls in children aged 0–19 in the WHO European Region, 2003–2005 or most recent three years



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: European detailed mortality database (DMDB) [online database] *(5)*.

Falls kill more boys than girls, particularly in the group aged 15–19 years in which boys are four times more likely to die (Fig. 7.2). Types of fall-related injury differ for different age groups. Infants are most likely to fall from furniture or as a result of being dropped; children aged 1–3 years are most likely to fall from stairs and steps, windows, balconies, furniture or play equipment; and older children, from playground equipment and heights such as fire escapes, roofs and balconies *(6,7)*. Data from the German Health Interview and Examination Survey for Children and Adolescents, covering the period May 2003 to May 2006, show that falls cause 60% of all injuries among children and adolescents aged 1–17 years, and that 36% of all injured children aged 1–4 fell from heights, including from stairs and from playground equipment *(8)*.

Figure 7.2
Age- and gender-specific mortality rates from falls in children in the WHO European Region, 2003–2005 or most recent three years



Source: The global burden of disease: 2004 update [website] *(4)*.

Falls are often the most common cause of fatal and serious head injuries among young children, as noted in studies from England, Wales, Scotland and France *(9,10)*.

7.2.2 Morbidity

Non-fatal falls occur much more frequently than fatal ones and place a great burden on health care facilities throughout the European Region. In children aged under 15, falls are the sixth overall cause of DALYs lost for boys and the twelfth overall cause for girls (Annex 4, Table 6). Falls have the greatest burden of all injuries for children under 15, and are the most common type of childhood injury presenting at emergency departments in most countries.

For example, falls in the home and garden accounted for nearly half of all unintentional home injuries in the United Kingdom in 2002. An estimated 390 800 children under 15 were taken to hospital with injuries resulting from such falls. Almost 60% were aged under 5 years and 56% of those were boys *(11)*. A Hungarian survey, examining children and young people aged 11–17 years in 2006, found that falls accounted for 42% of the most serious medically treated injuries and were more prevalent in younger age groups; they occurred in sports halls (29%), streets and roads (24%), the home (23%) and school (17%) *(12)*. Hospitalization data from Israel in 2005 indicated that the falls leading to hospital admissions of children aged 0–17 years occured at home (50%), at school (10%), in streets and roads (9%), in a playground (4%), in public buildings/entertainment and commercial areas (4%), in sports facilities (3%) and at other/unspecified locations (21%) *(13)*.

For young children, falls are the leading cause of traumatic brain injury, with a significant risk of long-term neurological damage *(14,15)*. In Sweden, half of mild brain injuries in children aged 0–4 years have been reported to be associated with falls from child-care products, most commonly nursery furniture *(16)*. Nursery equipment was also implicated in more than 36% of the 4400 infant fall injuries occurring annually in Greece. One in ten of these infants required hospitalization, often for a concussion or fracture *(17)*.

7.2.3 Costs

Falls are costly, yet data on these costs are not readily available throughout the Region. Only a few countries have made cost calculations for their national falls data, using models based on national health care costs.

One example comes from the Netherlands, where falls are the primary cause of emergency-department visits for those aged 0–17 years, making up 55% of all such visits related to injury. On average, 140 000 cases (3800 per 100 000) are treated each year. The average direct medical cost of an individual fall (with treatment in an emergency department or hospital) is €860, making the country's total medical costs €120 million a year for falls in children under 18. A more detailed examination of some types of falls shows that each year 7400 children fall from staircases (210 per 100 000 children) with a total medical cost of €6.3 million, and 5600 fall from playground equipment (160 per 100 000) with a cost of €5.9 million (18). According to a study in emergency departments in Turkey, falls account for 41% of injury admissions and account for a major share of the overall paediatric trauma budget *(19)*.

7.3 Risk factors

The occurrence of falls depends on a number of factors, including children's age and development and the surroundings in which they spend most of their time. The most common type of fall leading to hospitalization is from one level to another: for example, from changing tables, stairs, beds/bunk-beds, windows, balconies and playground equipment. Children living in poorer households and communities are at greater risk. The severity of a fall also

depends on the height from which one falls, the type of surface fallen to and the circumstances of the fall, such as falling down the stairs with a baby walker *(20)*.

7.3.1 Age, developmental stage and gender

Young children are at greatest risk of falling because their urge to explore their surroundings usually does not match their capacity to assess or react to risks. They may stand on high chairs, lean out windows or crawl off balconies or staircases *(21)*. Young children most often fall from nursery furniture at home or in child-care settings, where they spend most of their time. As children grow and travel farther from home, falls occur in other settings such as playgrounds and schools. Adolescents often undertake more challenging or risky actions, which can involve not only more demanding physical movement but also more dangerous settings such as abandoned work sites *(22)*.

Boys have greater risks than girls of falling at all ages (Fig. 7.2) and of both fatal and non-fatal falls *(23)*, perhaps because boys are more physically active, play rougher and take greater risks *(22)*.

7.3.2 Environments

The built environment, whether housing or playgrounds, and the products children use are implicated in falls *(24)*.

Most children's falls occur in or around the home. While some are related to products for children, most have to do with the design and maintenance of housing and recreation areas. Unsafe building designs, inadequate property maintenance, particularly of low-income rental properties, and product designs that do not take account of young children's developmental abilities or their families' needs are risk factors. Examples include poor lighting; lack of window guards, safety catches and restrictors in high-rise buildings; no fixing points for stair gates; missing guardrails for stairs; unsafe balconies; and open roof access. These deficits may be concentrated in deprived urban areas, where the socioeconomically disadvantaged may be housed *(25)*.

7.3.3 Consumer products

Strollers, prams, baby walkers, high chairs, changing tables, cots and baby exercisers are the products most commonly associated with non-fatal injuries in infants and young children in Europe *(26)*. For example, data in Sweden implicate high chairs, changing tables and prams in falls in children aged 0–3 years. Over 10% of the children injured suffer concussions, and 50% suffer some other injury to the head or face *(27)*.

The EU injury database identifies bicycles, roller skates and swings as the three leading consumer products implicated in home and leisure injuries, the majority due to falls *(28)*.

Fall-related injuries in older children are associated with leisure activities and equipment, such as in-line skates, skateboards or trampolines; in particular, falls from trampolines can cause limb fractures, sprains and head injuries *(29–31)*.

Globalization and open markets have spread a wide range of consumer products throughout the Region. Some of these products are beneficial, but some can be hazardous to children if safety requirements are not met. The single market was created to enhance a consistent and safe approach to products in the EU, and Member States have harmonized many of their laws *(32)*. The Directive on general product safety *(33)*, most recently revised in 2004, aims to protect consumers' health and safety and ensure the proper functioning of the internal market throughout the EU. The Directive includes issues related to producers' obligations and the authorities' powers and tasks, including reporting of injuries.

Within its framework, the Directive provides the rapid alert system for non-food consumer products (RAPEX) between Member States and the Commission. RAPEX ensures that relevant authorities are rapidly informed of dangerous products and that corrective measures can be applied. Under certain circumstances, the EU may exchange rapid alert notifications with non-EU countries. Equipment related to children's falls is among the consumer products most frequently covered by RAPEX notifications *(26)*.

7.3.4 Playground equipment

As children grow, falls related to physical activity, such as those from playground equipment onto a hard surface *(34)*, increase *(35)*. Such falls often appear in hospitalization data in HICs *(36)*. Studies report significant associations between specific structural features of playgrounds, such as greater height of equipment and less absorbent contact surfaces, and fall injuries *(37)*.

Investigations from Greece reported an increased risk of fall injuries in playgrounds not adhering to accepted safety standards, such as having appropriate surface materials of sufficient depth, and adequate handrails or guardrails *(38)*. In Sweden, about 12 000 injuries occur each year at playgrounds: 6% of children's injuries. Between 1995 and 1996, about 55% of these registered playground incidents resulted in fractures, concussions or dislocated joints. A survey found that many playgrounds were poorly designed or maintained, increasing the risk of injury *(39)*.

No European regulations have been made for playgrounds, but there are voluntary standards for playground equipment and impact-absorbing surfaces. Playgrounds and, if applicable, impact-absorbing surfaces should conform to standards EN 1176 and EN 1177, respectively. A further voluntary standard, EN 71–8, applies specifically to playground equipment for residential use *(40)*.

7.3.5 Contact with animals

With an increase in horse riding as a leisure activity and children working on rural farms, studies in HICs have shown an increase in the number of children presenting to hospitals for falls from horses *(41)*. Although such falls

are less frequent than those from other causes, they can have serious outcomes. In the Netherlands, for example, a study estimated that up to 40% of children and adolescents treated in hospital after falling off a horse had a disability four years later *(42)*.

7.3.6 Poverty

In the European Region, a higher risk of fall mortality is strongly related not only to country income but also social class. For example, children from the most deprived backgrounds have six times the risk of dying from falls than the well-off in the United Kingdom *(43)*. Poorer children have greater exposure to overcrowding, hazardous environments, single or unemployed parents, younger and less educated mothers, caregivers with stress and other mental health problems, and inequities in access to health care *(3,44)*.

7.3.7 Supervision

Inadequate adult supervision in unsafe environments is an important factor in childhood injuries *(45,46)*. The issues involved are complex, however, and interact with the many other social issues that affect the most vulnerable and at-risk families. For example, children from poorer families may be left on their own more often and given the responsibility of supervising younger family members. Preschool children should not be left unsupervised for more than 5 minutes at a time *(46)*.

7.3.8 Work environments

Children in the workplace are at substantial risk of falls due to the demands in excess of their size, strength, stamina and developmental abilities *(47)*. A number of factors compound the risk, including long work shifts and fatigue; exposure to heat, cold, noise and toxins; poor ventilation and lighting; malnutrition and musculoskeletal disorders; unsafe machinery and tools primarily designed for use by adults; and inadequate safety and protective equipment, supervision and training *(48)*.

Agriculture has the highest incidence of fatal injuries to young workers (those aged 15–24). In Ireland, falls from heights were found to be one of the primary causes of fatal injuries for all ages on farms. Whether as workers, residents or visitors, children were the victims of over 30% of Irish farm fatalities in 2001 *(49)*.

The construction sector has the highest number of fatal work unintentional injuries to young workers, many of which are falls *(50)*. According to Council Directive 94/33/EC on young people at work, which applies to those aged 18 and younger, employers are obliged to guarantee that work is not harmful to young people's safety, health or development as a consequence of their lack of experience or awareness of existing or potential risks, or the fact that their body systems are not yet fully mature. The Directive aims to protect young workers from higher-risk activities *(51)*.

7.4 What can be done

Falls can be reduced by adopting, implementing and enforcing strategies that have been demonstrated to be effective. The high burden of falls, particularly from head injuries, increases the need for prevention.

7.4.1 Environmental and engineering approaches

Environmental and engineering changes can be some of the most effective preventive measures. Identifying, replacing or modifying unsafe products has reduced falls in children. This includes, for example, replacing changing tables with changing mats, removing wheels from or applying brake mechanisms to baby walkers, reducing the height of and using guardrails on bunk-beds, reducing the height of playground equipment and improving landing surfaces *(52)*.

Protective equipment has been demonstrated to minimize the severity of fall injury: for example, wearing a helmet while riding a horse *(53)*. In addition, helmets and wrist guards should be used in all forms of skating to reduce head injury and fractures *(31)*.

In the home, providing lower-income families with safety equipment (such as stair gates) and installing it free can improve safety practices *(54)*. In addition, estimates have shown that increasing stair-tread depths in new dwellings in the United Kingdom would prevent over 1250 accidents and probably 2 deaths in the first 5 years of implementation. All steps and staircases in the home should have a rise not exceeding 170 mm and a depth of at least 250 mm *(55)*. Box 7.2 also addresses aspects of housing design.

BOX 7.2

Improving the safety of housing design *(56,57)*

The Housing Health and Safety Rating System (HHSRS) was developed in England between 1998 and 2004. It focuses on potential threats to health and safety from defects in design of housing; 29 potential housing hazards have been identified for HHSRS, all of which are to some extent attributable to the state and condition of the dwelling. Of these potential hazards, 11 address the risk of injury, such as those from falls, electric shock, burns and scalds, and collisions.

During the development of HHSRS, data on injuries requiring medical attention were matched with housing data and analysed to give the likelihood and severity of an injury over a twelve-month period. The analysis was broken down by age groups to make it possible to identify whether a particular group was more vulnerable to a particular type of injury. The HHSRS includes the profiles of hazards for children, and local authorities are using it for the regulation and maintenance of new housing to ensure that homes are safe environments for children.

Sources: Housing Health and Safety Rating System operating guidance *(56)* Statistical evidence to support the Housing Health and Safety Rating System (HHSRS): volumes I–III [web site] *(57)*.

Implementing playground standards for the depth of appropriate surface material, height of equipment and maintenance helps to reduce the frequency and severity of fall injuries. Ensuring a depth of 23–31 cm for surfacing materials such as sand or wood chips can prevent injuries. The optimal equipment height to reduce the risk of head injury is 1.5 m *(52)*.

7.4.2 Legislation and standards

Making and enforcing legislation requiring environmental or engineering improvements – such as the installation of window guards, safety catches and restrictors by landlords – is a proven preventive strategy. Fatal falls of young children from high-rise buildings greatly decreased in one state in the United States following the passage of legislation on window-guard installation *(58)*. Greece, Scotland and Sweden all have national laws requiring environmental changes (such as window guards or locks) to prevent children from falling out of windows in buildings of more than one story/level *(59)*.

The Czech Republic, Hungary, Italy, the Netherlands, Poland, Portugal, Slovenia, Slovakia and Spain report that their housing policies directly address child safety, but Finland, Italy, Portugal and Spain are the only countries with safety-related housing policies specifically targeting homes *(60)*. No specific legislation or directive sets housing standards or requirements across the EU *(61)*. Portugal is preparing a national standard for balconies and stairs/barriers/guardrails in buildings (Box 7.3).

BOX 7.3

Government action to prevent falls in Portugal

In Portugal at least 13 children were reported to have fallen from buildings in 2007, and 7 more fell in the first half of 2008, with severe but not fatal consequences.

In May of 2008, a 17-month-old boy from a low-income immigrant family living in a first-floor apartment crawled through a gap in a balcony and fell to the ground. He sustained a serious head injury and required eight days of hospitalization, including five days in the intensive care unit, and neurosurgical follow-up and rehabilitation after discharge.

As there is no EU standard, Portugal is preparing a national standard for balconies and stairs/barriers/guardrails in buildings with the support of a multidisciplinary technical committee mandated by the national government. One of the agreed principles is that barriers must protect young children. Thus, barriers used in both private and public buildings should be at least 110 cm high, have gaps no wider than 9 cm and neither be climbable nor encourage climbing. Once this standard is completed, the Portuguese Government will need to determine how it can be applied, particularly to existing buildings.

Source: Portuguese Association for Child Safety *(62)*.

Enforcing standards requiring safe depth and regular maintenance of specified types of surfacing materials is more effective than simply making such standards in reducing injuries related to playground equipment *(52)*. Although the EU playground-safety standards are voluntary, some countries have legally binding national safety standards for playground equipment, including Austria, Belgium, the Czech Republic, Denmark, France, Germany, Greece, Hungary, the Netherlands, Poland and Sweden *(59)*.

7.4.3 Combined strategies

As with other types of injury, combining a number of proven strategies to prevent falls increases their effectiveness.

Home-based social support, such as home visiting programmes for new mothers, can significantly reduce the rates of child injury. Such visits to families with young children can educate them about the need to use safety equipment such as window bars and stair gates, and not to use hazard-producing products such as baby walkers *(63)*. Two systematic reviews concluded that parenting interventions using multifaceted interventions, most commonly provided in the home, can reduce child injury, particularly in families at risk of adverse child health outcomes *(64,65)*. Belgium, Denmark, Northern Ireland, Norway and Sweden offer programmes of home visits that include education on preventing child falls *(59)*.

Multiple strategies repeated in different forms and contexts are an important means of fostering a culture of safety in communities *(66,67)*. Community-based prevention programmes often include strategies on falls and have been demonstrated lead to the installation of window guards in high-rise buildings *(68)*.

7.5 Conclusions

Falls can seriously harm the child, family and society. Children from socioeconomically deprived backgrounds are at increased risk of fatal and non-fatal injuries and this inequity needs to be addressed. Action in the European Region is immediately needed to adopt, implement and enforce policies proved to be successful in reducing falls. The successes and failures of intervention strategies in HICs and communities can provide useful information if the lessons learnt can be transferred to fall prevention initiatives in lower-resource settings (Box 7.4).

BOX 7.4

Messages for policy-makers

- Falls are the most common cause of injury-related hospital admissions and emergency-department visits for children, and may result in serious consequences for families and high costs to health care systems.
- Creating and managing safe environments and products for children is critical in reducing their risks of serious falls.
- Proven preventive strategies include modifying unsafe products, implementing playground standards, passing legislation requiring window guards and implementing multifaceted community programmes.

7.6 References

1. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization (in press).
2. American Academy of Paediatrics. Falls from heights: windows, roofs and balconies. *Pediatrics*, 2001, 107:1188–1191.
3. Dowswell T et al. *Accidental falls: fatalities and injuries. An examination of the data sources and review of the literature on preventive strategies*. Newcastle, University of Newcastle upon Tyne, 1999.
4. The global burden of disease: 2004 update [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html, accessed 10 November 2008).
5. European detailed mortality database (DMDB) [online database]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Data/20070615_2, accessed 13 November 2008).
6. Flavin M et al. Stages of development and injury patterns in the early years: a population-based analysis. *BMC Public Health*, 2006, 6:187.
7. Schelp L et al. School accidents during a three school-years period in a Swedish municipality. *Public Health*, 1991, 105:113–120.
8. Kahl H et al. Injuries among children and adolescents (1–17 years) and implementation of safety measures. Results of the nation wide German Health Interview and Examination Survey for Children and Adolescents *Bundesgesundheitsbl-Gesundheitsforsch-Gesundheitsschutz*, 2007, 50:718–727.
9. Williamson L et al. Trends in head injury mortality among 0–14 year olds in Scotland (1986–95). *Journal of Epidemiology & Community Health*, 2002, 56:285–288.
10. Tiret L et al. The epidemiology of head trauma in Aquitaine (France), 1986: a community-based study of hospital admissions and deaths. *International Journal of Epidemiology*, 1990, 19:133–140.
11. *Factsheet: falls in the home*. London, Child Accident Prevention Trust. 2008 (http://www.capt.org.uk/FAQ/default.htm, accessed 18 November 2008).
12. Páll G, ed. *Injuries, accidents. Health and life-style of adolescents. National Research Report of Health Behaviour in School-aged Children 2006 survey*. Budapest, National Institute of Child Health, 2007.
13. Israel National Center for Trauma and Emergency Medicine Research, Gertner Institute for Epidemiology and Health Policy Research, Sheba Medical Center, Tel Hashomer, Israel. In: Tzionit Y, Kimchi M & Ben-Arieh A. (Eds.). *Children in Israel 2007: Statistical Abstract*. Jerusalem, The National Council for Child Welfare, 2007.
14. Goodacre S et al. Can the distance fallen predict serious injury after a fall from a height? *Journal of Trauma-Injury Infection & Critical Care*, 1999, 46:1055–1058.
15. Hyder A et al. The impact of traumatic brain injuries: a global perspective. *Neurorehabilitation*, 2007, 22:341.
16. Emanuelson I. How safe are childcare products, toys and playground equipment? A Swedish analysis of mild brain injuries at home and during leisure time 1998–1999. *Injury Control and Safety Promotion*, 2003, 10.
17. Dedoukou X et al. Incidence and risk factors of fall injuries among infants: a study in Greece. *Archives of Pediatric and Adolescent Medicine*, 2004, 10.
18. *Frequency and cost calculation of falls for children 0 to 17 years of age in the Netherlands. Injury data base for the Netherlands*. Amsterdam, Consumer Safety Institute, 2008.
19. Gurses D et al. Cost factors in pediatric trauma. *Canadian Journal of Surgery*, 2003, 46:441–445.
20. Khambalia A et al. Risk factors for unintentional injuries due to falls in children aged 0–6 years: a systematic review. *Injury Prevention*, 2006, 12.
21. Jordan J, Valdes-Lazo F. Education on safety and risk. In: Manciaux M, Romer C, eds. *Accidents in childhood and adolescence: the role of research*. Geneva, World Health Organization, 1991.
22. Morrison A, Stone D. Unintentional childhood injury mortality in Europe 1984–93: a report from the WHO Regional Office for EuropeRISC Working Group. *Injury Prevention*, 1999, 5:171–176.
23. Kumpula H, Paavola M. *Injuries and risk-taking among young people in Europe – The European situational analysis. EU-Project AdRisk*. Helsinki, National Public Health Institute, 2008 (http://www.adrisk.eu.com, accessed 13 November 2008).
24. Cummins S, Jackson R. The built environment and children's health. *Pediatric Clinics of North America*, 2001, 48:1241–1252.
25. European Environment and Health Information System (ENHIS). *Comparative Assessment of policies on housing safety in 18 countries of the European Union*. Copenhagen, WHO Regional Office for Europe, 2007.
26. RAPEX notification search engine [online database]. Brussels, European Commission, 2008 (http://ec.europa.eu/consumers/dyna/rapex/rapex_archives_en.htm accessed 18 November 2008).
27. Swedish Consumer Agency. *Brief Facts on Injuries: falling accidents among young children*. Center for Epidemiology, National Board of Health and Welfare. Stockholm, 2002.
28. Zimmerman N, Bauer R. *Injuries in the European Union: Statistics summary 2002-2004*. Vienna, EuroSafe, 2006.
29. Linakis J et al. Emergency department visits for pediatric trampoline-related injuries: an update. *Academic Emergency Medicine*, 2007, 14:539–544.
30. Edwards D. Tarzan swings: a dangerous new epidemic. *British Journal of Sports Medicine*, 1991, 25:168–169.
31. Knox C, Comstock R. Video analysis of falls experienced by paediatric iceskaters and roller/inline skaters. *British Journal of Sports Medicine*, 2006, 40:268–271.
32. Vincenten J, Farquar B. *A guide to child safety regulations and standards in Europe*. Amsterdam, European Child Safety Alliance, 2003.
33. Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety. Brussels, European Commission, 2001 (http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Directive&an_doc=2001&nu_doc=95, accessed 18 November 2008).

34. Norton C et al. Playground injuries to children. *Archives of Disease in Childhood*, 2004, 89:103–108.
35. Watson W et al. *Consumer product related injury to children*. Melbourne, Accident Research Centre, Monash University, 2000.
36. Chalmers D, Langley J. Epidemiology of playground equipment injuries resulting in hospitalization. *Journal of Paediatrics & Child Health*, 1990, 26:329–334.
37. Mayr J et al. Playground accidents. *Acta Paediatrica*, 1995, 84:573–576.
38. Petridou E et al. Injuries in public and private playgrounds: the relative contribution of structural, equipment and human factors. *Acta Paediatrica*, 2002, 91:691–697.
39. *Market survey of playground equipment*. Stockholm, Swedish Consumer Agency, 1999.
40. *Council directive 88/378/EEC on the safety of toys*. Official Journal of the European Union. C 237/15. 16 September 2008, Brussels, European Commission, 2008 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:237:0014:0015:EN:PDF, accessed 18 November 2008).
41. Smith G et al. Pediatric farm-related injuries: a series of 96 hospitalized patients. *Clinical Pediatrics*, 2004, 43:335–342.
42. Dekker R et al. Long-term outcome of equestrian injuries in children. *Disability & Rehabilitation*, 2004, 26:91–96.
43. Roberts I. Cause specific social class mortality differentials for child injury and poisoning in England and Wales. *Journal of Epidemiology and Community Health*, 1997, 51:334–335.
44. Engstrom K et al. Socioeconomic differences in injury risks in childhood and adolescence: a nation-wide study of intentional and unintentional injuries in Sweden. *Injury Prevention*, 2002, 8:137–142.
45. Morrongiello B. Caregiver supervision and child-injury risk. I. Issues in defining and measuring supervision;II. Findings and directions for future research. *Journal of Pediatric Psychology*, 2005, 30:536–552.
46. Peterson L et al. Judgments regarding appropriate child supervision to prevent injury: the role of environmental risk and child age. *Child Development*, 1993, 64:934–950.
47. Richter E, Jacobs J. Work injuries and exposures in children and young adults: review and recommendations for action. *American Journal of Industrial Medicine*, 1991, 19:747–769.
48. *Child labour: targeting the intolerable*. Geneva, International Labour Office, 1996 (http://www.ilo.org/public/english/comp/child/publ/target/target.pdf, accessed 18 November 2008).
49. *Code of practice on preventing accidents to children and young persons in agriculture*. Dublin, Health and Safety Authority Ireland, 2001.
50. European Agency for Safety and Health at Work. *OSH in figures: young workers – fact and figures, European risk observatory report*. Luxembourg, Office for the Official Publications of the European Union, 2007.
51. Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work. *Official Journal of the European Union*, 1994, L216 /12 – 20 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31994L0033:EN:HTML, accessed 18 November 1997).
52. Harbourview Injury Prevention and Research Center/Cochrane Collaboration. *Systematic Review Database*. Seattle, University of Washington, 2001.
53. Jagodzinski T, DeMuri G. Horse-related injuries in children: a review. *Wisconsin Medical Journal*, 2005, 104:50–54.
54. Watson M et al. Providing safety equipment to prevent injuries: randomized controlled trial. *BMJ*, 2005, 330:178–182.
55. *Can the home ever be safe: the need to improve safety in the built environment of homes and gardens*. Birmingham, Royal Society for the Prevention of Accidents, 2005.
56. *Housing Health and Safety Rating System operating guidance – Housing Act 2004. Guidance about inspections and assessment of hazards given under Section 9*. London, Office of the Deputy Prime Minister, 2006 (http://www.communities.gov.uk/documents/housing/pdf/142631.pdf, accessed 18 November 2008).
57. Statistical evidence to support the Housing Health and Safety Rating System (HHSRS): volumes I–III [web site]. London, Communities and Local Government, 2003 (http://www.communities.gov.uk/publications/housing/statisticalevidencesupport, accessed 18 November 2008).
58. Barlow B et al. Ten years of experience with falls from a height in children. *Journal of Pediatric Surgery*, 1983, 18:509–511.
59. MacKay M, Vincenten J. *Child safety summary report card for 18 countries – 2007*. Amsterdam, European Child Safety Alliance, 2007.
60. Zurlyte, I. State Environmental Health Centre Lithuania. Comparative Assessment of policies on housing safety in 18 countries of the European Union. Bonn, European Environment and Health Information System, 2007. (http://www.enhis.org/object_binary/o2788_Housing%20Policy%20Assessment%204%20-%20safety_141107.pdf, accessed 18 November 2008)
61. Ormandy, D. Personal Communication from the United Kingdom, 2008
62. Portuguese Association for Child Safety, (www.apsi.org.pt). Personal Communication from Portugal.
63. Kendrick D et al. Does home visiting improve the parenting and the quality of the home environment? A systematic review and meta analysis. *Archives of Disease in Childhood*, 2000, 82:443–451.
64. Kendrick D et al. Parenting interventions for the prevention of unintentional injuries in childhood. *Cochrane Database of Systematic Reviews* 2007, Issue 4. Art. No.: CD006020. DOI: 10.1002/14651858.CD006020.pub2
65. Roberts I et al. Does home visiting prevent childhood injury? A systematic review of randomised controlled trials. *BMJ*, 1996, 312:29–33.
66. Towner E, Dowswell T. Community-based childhood injury prevention: what works? *Health Promotion International*, 2002, 17:273–284.
67. Oldenburg B, Brodie AM. Trends and challenges in intervention research methods. In: Doll L et al., eds. *Handbook of injury and violence prevention*. New York, Springer, 2006:359–380.
68. Spiegel C, Lindaman F. Children can't fly: a program to prevent childhood morbidity and mortality from window falls. *American Journal of Public Health*, 1977, 67:1143–1147.

CHAPTER 8
CONCLUSIONS AND POINTS FOR ACTION

All injuries are acute events – a child who is well at breakfast may be killed or badly injured by a road traffic crash, drowning or burn later that day. This suddenness and unexpectedness have led to the popular myth that injuries are random events, not amenable to prevention or amelioration. Nothing could be further from the truth. While a catastrophe such as a train crash captures the public's attention, the daily loss of 115 children's lives to injuries in the WHO European Region receives little notice.

This report set out to highlight the enormous scale of the loss to society from childhood injuries in the Region, and the huge potential for prevention by addressing underlying risks and exposures. This view is drawn from the experience of several European countries that, through sustained and systematic work, have succeeded in becoming among the safest in the world.

This report is a companion to the *World report on child injury prevention* and provides evidence from a European perspective, taking account of the diversity and dramatic speed and breadth of socioeconomic and political changes in the Region *(1)*.

8.1 Cross-cutting themes

A number of themes are woven through the report, including the diversity of both the types and the environments of injuries across Europe, changes across the Region and over time, and children's vulnerability to injury and right to safety. Above all, the report stresses that social determinants and poverty are among the most important underlying factors in childhood injuries, as shown by the different rates of injury between and within countries. It also stresses that effective responses involve intersectoral action and should be coordinated by the health sector.

8.1.1 Diversity

The preceding chapters on the types of injury showed the diversity of the WHO European Region, including the much greater of likelihood of children dying from injuries in LMICs than in some HICs. For example, children in Kazakhstan have 20 times the risk of death from drowning of those in the United Kingdom.

While this diversity appears in both injury types and governments' and societies' responses to the problem, countries can learn from each other's successes and failures, and examples of evidence-based good practice developed in one country can be translated and tailored to the widely differing circumstances of others *(2)*.

8.1.2 Change

The European Region has experienced considerable change in the last 20 years. All countries have faced the challenges of globalization, but those in eastern Europe and the CIS have changed profoundly in all aspects of life. Rapid transitions to market economies have taken place in these countries, but have often been managed with little development of infrastructure and regulatory practices. Prior systems of social support and welfare have either been discontinued or proved inadequate to alleviate the widened socioeconomic gap. This has increased the vulnerability to injuries of some segments of society *(3–6)*. For example, the growth in use of motor vehicles has resulted in increased rates of RTIs in children in many countries. This is combined with a lack of societal response commensurate to the scale of the public health threat. These processes present new challenges for the Region's injury prevention community.

Further, the future implications of climate change need to be considered: the risks from extreme weather events such as floods will increase, and climate change may damage infrastructure and reduce health facilities' capacity to offer emergency services *(7)*. The situation also offers synergistic opportunities for response; a reduction in motorized transportation would not only reduce RTIs but also help tackle the epidemic of obesity by promoting walking and cycling *(8)*.

Large population movements occur in the Region. Some comprise temporary shifts resulting from tourists, who are exposed to hazards in new environments; others result from economic migrants, travellers and asylum seekers, who are vulnerable in new ways of life in unfamiliar societies, where they often live in poorer urban neighbourhoods in conditions of absolute or relative poverty compared to indigenous populations. Reports suggest that migrant children in such settings have 3–4 times the death rates from injuries of native populations, and this difference is greater for children than adults *(9)*.

8.1.3 Vulnerability

This report showed the strong association between the child's stage of life and the type of injuries sustained. The substantial

changes in children's physical and cognitive abilities and risk behaviour as they grow, make them susceptible to different types of injuries in different environments *(10,11)*.

Children are especially vulnerable because they live in a world, whether urban or rural, designed by and for adults, where they have little power and control *(12)*. Their voices are seldom heard, and only rarely are settings and new products designed to take account of their needs and with consideration of their vulnerability to injuries. The focus needs to be on making environments safer with passive safety measures, rather than relying solely on education and better supervision by adults.

8.1.4 Child rights

All countries across the WHO European Region ratified the Convention on the Rights of the Child *(13)*. The Convention includes children's rights to be listened to and taken seriously, to have safe environments and to be protected, and calls on the institutions, services and facilities responsible for the care or protection of children to conform to established standards, particularly those for safety and health. Safeguarding these rights everywhere is not easy, but concerted action can do it.

Interest in and commitment to involving young people in both programmes and research relating to issues that concern them are growing *(11)* (Box 8.1). Children and young people need to be consulted as effective agents of change. For example, the celebration of the First United Nations Global Road Safety Week involved a consultation with young people resulting in a Youth Declaration for Road Safety *(14)*, which calls on all young people to "stand up and participate in local and national campaigns and programmes", urges adults to do more and calls for more political will at the national and community levels to tackle road safety. A statement of commitment called on various groups to take action: young people, parents and caregivers, educational institutions, communities, governments, NGOs, private companies, the media, and celebrities and the entertainment world. This highlighted to policy-makers and practitioners young road users' concerns and priorities in making roads safer. Child consultation around safe environments has underpinned the implementation of the CEHAPE *(15,16)*, and the child-friendly version of the *World report on child injury prevention* emphasizes the importance of child involvement and participation *(17)*.

8.1.5 Social determinants and poverty

The burden of child injuries falls unequally. It is heaviest for poorer social groups and the LMICs in the Region (Table 2.2). Until recently, few of these countries had paid much attention to the issue; in contrast, initiatives started decades ago in the well-off northern and western countries in the Region.

Countries belonging to the Organisation for Economic Co-operation and Development (OECD) showed the potential for prevention and control by halving injury deaths in children under 15 years in the period from 1981 to 1995 *(2)*. All health systems, irrespective of country income, face competing priorities for resources but a growing evidence base supports the cost–effectiveness of injury prevention interventions. Programmes for injury prevention need to be implemented to reduce the unacceptably high burden of injuries, particularly in LMICs, where the greatest gains could be made *(21)*.

Child injury is a great drain on a family's material and emotional resources; it hits poorer families harder because they start with fewer social networks and the least social capital and material resources *(22)*. While many countries espouse the principle of universal health care, poorer and minority-group families may have inadequate access to high-quality health care, and the indirect costs (such as missing school, the loss of earnings for carers) and direct costs (such as the need to make co-payments or under-the-table payments) of caring for an injured or disabled child may place a heavier burden on them *(23)*. This may reduce their material resources and deepen their poverty.

The burden of child injury is greatest on low-income families in all countries. Factors in children's physical and social environment determine their exposure to risk, and influence lifestyle choices and access to safety interventions and health services *(22,24)*. As well as addressing the social determinants of injuries, approaches to redress the inequity of injuries would involve both passive interventions to make environments inherently safer for all and active interventions focusing on the disadvantaged. Only when this common theme is addressed will real progress be made. With few exceptions, wherever one finds high child injury rates, one finds poverty. Addressing this important cause of health inequalities is a matter of social and environmental justice.

BOX 8.1

Increasing use of child participation in the United Kingdom

In the United Kingdom, the Confidential Enquiry into Maternal and Child Health investigates the circumstances in which children and young people die. This includes consulting young people about their views on the issues, how to address them sensitively and how to report the findings of the review in an interesting and relevant manner *(18)*. Young people reviewed a sample of cases (including injuries) and said they felt that they needed greater awareness of danger in their lives, particularly related to substance abuse and traffic crashes. A separate report on the findings was produced for children and young people *(19)*.

In addition, the Mayor of London consulted children and young people on how to improve their daily living environments in 2004. It revealed that children believed that there was not enough space to play, that parks needed to be safer and better maintained, and that cheaper and safer public transport was needed *(20)*. They also said that they wanted to walk and cycle more and to have better housing and more child-friendly neighbourhoods. Their views were incorporated into London's strategy for children and young people.

8.1.6 Intersectoral action

The causes of all types of injury are linked to children's physical and social environments. The consequent preventive responses must involve intersectoral action across government, civil society, research institutes and the private sector. For example, transport policy affects child RTIs; housing policy, falls and burns in the home; regulation of products such as chemicals, poisoning; and policies on leisure environments such as playgrounds and swimming pools, the likelihood of a fall or drowning.

Further, social and economic policies affect families' susceptibility to injury. If governments are to address the uneven distribution of injuries and the resulting social injustice, then equity needs to be an aim across the whole of government policy, as recommended by the WHO Commission on Social Determinants of Health *(24)*. The health sector can play a key role, in advocating just action across government, promoting health equity in all policies and highlighting injuries as a consequence of social policies. It can do this by disseminating injury data that are disaggregated by social stratum to evaluate the effects of polices. Further, some policies seek to protect the disadvantaged across a broad range of health outcomes and injuries, including those addressing universal health care, early child development and education, healthy places, fair employment for parents and social protection. The health sector needs to incorporate injury prevention in its provision of universal primary health care and community-based action, and pay particular attention to targeting the social stratification of injuries.

8.1.7 Prevention and control

This report demonstrated that the problem of unintentional injuries can be addressed, and sustained reductions in injury mortality and morbidity can be achieved. Some countries in the European Region have the lowest child injury rates and the best safety records in the world. They have comprehensive, coordinated policies to address the problem through a holistic approach. They also have progressive social and welfare policies to give social and material support to the disadvantaged. Positive, committed leadership is essential, along with widespread efforts to provide safer physical and social environments *(5)*. Sweden was the first to recognize the threat of injuries to child health, tackle the problem in a coordinated manner and sustain this commitment over 50 years *(25)*. Swedish society's sense of corporate responsibility meant that a culture of safety could be nurtured, and the protection of children became a major societal goal.

When the league tables of child injury deaths are examined for the different types of injury – RTIs, drowning, falls, poisoning and thermal injuries – the five leading countries for each type differ. This suggests that all countries could improve their performance and reduce deaths for some injury types. Even HICs with lower overall rates show significant differences by socioeconomic status; this further emphasizes the continued need for improvements in all countries in the Region.

This report examined the prevention of five major injury types. For each, the evidence indicates that a range of approaches – legislation, regulation and enforcement, product modification, environmental modification, education and skills development and emergency medical care – can prevent or reduce the impact of injuries (Table 8.1).

Table 8.1
Some effective interventions to prevent child injuries

	Injury type				
Intervention principle	RTIs	Drowning	Thermal injuries	Falls	Poisoning
Legislation, regulation and enforcement (including standards)	Speed limits, drink–driving, bicycle helmets, seat-belts and child restraints	Pool fencing, supervision of swimming pools	Hot water heater temperature, smoke alarms	Playground equipment	Manufacture, storage and distribution of harmful substances, safe packaging
Product modification	Vehicle modification to improve occupant protection	Personal floatation devices	Curly flexes on kettles, thermostatic mixing valves	Reduced height of playground equipment, modification of baby walkers, safety glass	Medication packaging, child-resistant container closures
Environmental modification	Child-friendly infrastructure: safer routes to school, play spaces, pedestrianized areas	Barriers and fencing around water, heavy grills to cover wells	Electrification, separation of cooking from living areas	Window guards, railings on balconies, stair gates	Safe storage of potentially harmful substances
Education and skill development	Use of helmets, seat-belts, child restraints	Swimming training and supervision	Cooking practices, first aid	Supportive home visitation to identify hazards	Safe storage of household chemicals and pharmaceuticals, immediate first aid
Emergency medical care	Child-sized equipment, child trauma centres	Immediate resuscitation	Burn centres	Acute care appropriate to children	Poison control centres

Source: adapted from Peden et al. *(1)*.

All these approaches can play a part, and they are often more effective in combination. Injury prevention has been shown to be very cost-effective: the costs of interventions are often much lower than those of the consequences of injury (Table 8.2). Costs and the resulting savings have not been calculated for many interventions known to be effective, and research needs to close this gap *(26–29)*. In any case, the implementation of effective interventions around the European Region would save many thousands of lives and considerable health care costs.

This report provided examples of good practice and policies to enhance child safety and reduce injuries. These need to be adopted and implemented by all countries in the Region on a larger scale.

Table 8.2
Financial savings from selected injury prevention interventions

Expenditure of €1 each	Savings (€)
Smoke alarms	69.0
Car child restraints	29.0
Bicycle helmets	29.0
Motorcycle helmets	16.0
Upgraded marked pedestrian crossings	14.0
Roadside lighting	10.7
Guardrails on roadsides	10.4
Prevention counselling by paediatricians	10.0
Area-wide speed and traffic management	9.7
Poison control centres	7.0
Daytime running lights (normal bulbs)	4.4
Pedestrian bridges or underpasses	2.5

Sources: Data from *Cost effective EU transport safety measures (27)*, Miller & Levy *(28)* and Cost–benefit analysis of measures for vulnerable road users *(29)*.

An action spectrum has been proposed for the process through which different European countries have dealt with socioeconomic inequalities in health *(30,31)*. This includes a range of indicators related to inequalities in health, such as the establishment of national research programmes or commissions of enquiry, the strengthening of national information systems to facilitate measurement and monitoring, publication of government reports and particularly statements or legislative bills. An assessment of countries using these indicators reveals a spectrum of readiness and receptivity to social inequalities in health: moving from countries that do not even measure the extent of the problem to those that measure, recognize and raise awareness of it, those that deny its importance and those concerned about it and willing to act. Then come countries moving from isolated initiatives to more structured developments and then comprehensive coordinated policies to address the problem.

The action spectrum should not be regarded as a linear process and countries do not necessarily go through all stages. Child safety policies must be built on a strong foundation of good data on mortality, morbidity and exposure. International networks of focal points at national health ministries, researchers and practitioners can stimulate the rapid dissemination of good practice and ideas between countries.

8.1.8 Potential lives saved

Reducing all countries' mortality rates to the lowest rates – by transferring successful strategies between countries – is estimated to be able to prevent three out of four deaths from injury in the Region, saving 24 000 lives per year (see Annex 2 for methods). The current inequalities in injury mortality and disability in the Region are ethically unacceptable in view of the strong evidence that prevention works. Organized efforts by society could dramatically reduce the senseless loss of children's lives.

Table 8.3
Potential lives saved if all mortality rates in the WHO European Region were the same as the lowest national rates, 2003–2005 or three most recent years

	Injury types						All unintentional injuries
Health costs and benefits	Falls	Fire	Poisoning	RTIs	Drowning	Other	
Number of:							
average deaths per year	1 530	1 258	2 202	13 910	5 156	9 086	33 140
deaths expected	137	83	163	6 053	595	1 665	8 694
lives saved	1 393	1 175	2 040	7 857	4 561	7 421	24 447
Lives saved (%)	91	93	93	56	88	82	74

8.2 The way forward

The World Health Assembly, the WHO Regional Committee for Europe and the European Council call on the health sector to take the lead in coordinating a multisectoral response to injury prevention *(32–34)*. These calls have proved to be a catalyst for change in 26 out of 36 countries (72%) that participated in a survey on the prevention of injuries. During the past year, progress has been made in the following key items of the European resolution *(33)*: national policy development in 20 out of 30 countries (68%), surveillance in 18 (61%) countries and capacity building in 17 countries (58%). While 31 out of 36 countries (86%) have national policies for road safety, half or fewer had them for poisoning, falls, fires or drowning. Similarly, most countries were implementing a range of evidence-based preventive programmes for road safety, but much fewer addressed drowning, falls, fires and poisoning. The review concluded that, although progress is being made, the health sector needs to be more committed to widespread implementation in both number and coverage of programmes, and to engage with other stakeholders in a multisectoral response to prevent injuries *(35)*.

8.2.1 Action points

The Tallinn Charter *(36)* and Regional Committee resolution RC58/R9 on stewardship/governance of health systems *(37)* promote the principles of equity, social justice and universality. Nine action points for developing child injury prevention programmes are recommended here. They are in synergy with European and international policy initiatives.

1. **Provide leadership in integrating child injury prevention into a comprehensive approach to child and adolescent health development**. A comprehensive strategy for child and adolescent health and development needs to include injuries, because it is among the leading causes of ill health and disability. All governments, health ministries and civil-society organizations need to revise or reorient their child and adolescent health programmes to include child injury prevention. The European strategy for child and adolescent health and development *(38)* emphasizes this need, and stronger action is needed. Action plans and monitoring mechanisms for implementation should be integrated in the process. Such a comprehensive approach will optimize the allocation of scarce human resources to optimize health gain.

2. **Develop and implement a child injury prevention policy and plan that involves other sectors**. Health ministries should prepare policies and plans for child injury prevention and control that involve ministries concerned with transport, health, planning, leisure, housing, consumer product safety, agriculture, education, law and other subjects. Efforts should be multidisciplinary, with broad representation from different sectors of government, the private sector, NGOs, the media and the general public, including children and young people. Strategies should take account of the needs of all children, particularly the vulnerable, such as those who are poor, migrants, refugees and members of minority groups such as the Roma community. The strategies should be linked to and coordinated with other child health initiatives, particularly those promoting physical activity through walking, cycling and swimming in safe environments, and the safe use of public transport. Plans could stand alone or be developed as part of existing initiatives, building for example on the national activities catalysed by the CEHAPE *(16)* and European strategy for child and adolescent health and development *(38)* and the related tools for assessment, dissemination of information, and action.

3. **Take evidence-based action to prevent and control childhood injuries**. The evidence is sufficient to start taking the action needed to prevent and control child injuries and minimize their consequences. This action should be based on sound evidence on and analysis of the national and local situations, adapted as needed and evaluated. Whenever possible, it should form part of the national child health strategy. Key approaches need to include legislation, regulation and enforcement, product and environmental modification, education and skills development, and emergency medical care.

4. **Strengthen health systems to address child injuries**. Health systems' responses need to incorporate both primary prevention and the provision of high-quality care to injured children, as well as rehabilitation and support services. The principles of equity and evidence-based practice should underpin these actions. These improvements should include an efficient pre-hospital care system, high-quality acute care in hospitals and clinics, the use of child-specific equipment and drugs, rehabilitation programmes that address both the physical and psychological sequelae of injuries, and a holistic approach involving coordination with allied sectors. The health ministry focal person for injury prevention is well placed to coordinate such activities.

5. **Build capacity and exchange best practice**. An essential part of an adequate health-system response is ensuring a supply of sufficiently trained and experienced staff. Appropriate training programmes should be a priority in the development and implementation of an effective programme for child injuries involving both prevention and care. Networks comprising, for example, health-ministry focal points and NGOs such the European Child Safety Alliance of EuroSafe can disseminate good practice. Curricula focusing on injury prevention, such as that of TEACH-VIP *(39)*, need to be mainstreamed into

curricula for health professionals. The MENTOR-VIP programme, which pairs junior and senior researchers across the Region, aims to stimulate collaboration *(40)*. International conferences provide opportunities to exchange knowledge, establish networks and potential partnerships, and strengthen country capacity. Further, children and young people need to be included; the introduction of injury prevention activities into school and university curricula may help to sensitize young people to the risk of injuries.

6. **Enhance the quality and quantity of data for child injury prevention**. As mentioned, good mortality, morbidity and exposure data provide a foundation for the development and monitoring of policies affecting child safety. While good mortality data are available in most parts of the Region, they could be improved in a dozen countries. Most countries have room for improvement in collating information on the circumstances of and activities surrounding an injury, which is essential to understanding exposure and risks and developing responses. To address the impact of social policies on injury incidence, data are also needed with geographical area and by socioeconomic indicators.

7. **Define priorities for and support research on and evaluation of the causes, consequences, costs and prevention of child injuries**. Research agendas for child injuries need to be developed at the regional and national levels, based on appropriate evidence and input from a broad range of stakeholders across sectors. They should strengthen research on key issues such as:
   - economic analysis, including the cost of child injuries and interventions;
   - large-scale intervention trials, especially in LMICs;
   - research on non-fatal outcomes and disability; and
   - research to integrate injury prevention interventions into child health programmes and other settings.

   Assessing the costs against the benefits of specific interventions and setting priorities for the best investment of scarce financial and human resources are important for engaging other sectors in injury prevention. Successful research requires focused investment in human and technical capacity to build a critical mass of trained researchers. Across regions and countries, research skills should be strengthened in a variety of fields, including epidemiology, economics, engineering, social sciences, behavioural psychology, product evaluation, clinical trials and policy analysis.

8. **Raise awareness of and target investments in child injury prevention**. Raising awareness about the preventability of childhood injuries is paramount. A crucial part of this is promoting safer environments for children. Potential targets are the general public, including children and young people, health and other professional groups, the private sector, politicians and policy-makers and funding agencies. Advocates for child safety are needed, and children themselves need to be more engaged in the task. International NGOs and the private sector can help raise awareness locally and globally. Further, health systems need to advocate broad government policy leading to safer physical and social environments.

9. **Address inequity in child injury**. If governments are to address the inequitable distribution of injuries and the resulting social injustice, equity needs to be incorporated in the whole of government policy, as recommended by the WHO Commission on Social Determinants of Health *(24)*. The health sector can play a key role in advocating just action across government by promoting health equity in all policies and highlighting injuries as a consequence of social policies. This requires the dissemination of injury data disaggregated by social stratum to evaluate policies' effects. In addition, some policies seek to protect the disadvantaged across a broad range of health outcomes and injuries, including those addressing universal health care, early child development and education, healthy places, fair employment for parents and social protection. The health sector needs to incorporate injury prevention in its provision of universal primary health care and support of community-based action, and pay particular attention to targeting the social stratification of injuries.

8.3 Conclusion

Despite the burden in the European Region, particularly in LMICs, few countries have devoted adequate resources to preventing unintentional injuries in children and young people *(35,41,42)*. Societies have a responsibility to protect children and young people and to provide safe environments for them at home, at play and leisure, on the roads, at school and at work. Child health programmes throughout the European Region must ensure that they include childhood injury prevention and control. This important problem requires attention, commitment, resources and action now. Achieving greater justice in Europe demands the elimination of inequity in injuries in children.

8.4 References

1. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization (in press).
2. *A league table of child deaths by injury in rich nations*. Florence, UNICEF Innocenti Research Centre, 2001 (http://www.unicef-icdc.org/publications/pdf/repcard2e.pdf, accessed 17 November 2008).
3. Koupilova I et al. Injuries: a public health threat children and adolescents in the European Region. In: Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002: 130–140 (Environmental Issue Report 29).

4. McKee M et al. Health policy-making in central and eastern Europe: why has there been so little action on injuries? *Health Policy and Planning*, 2000, 15.
5. Sethi D et al. Reducing inequalities from injuries in Europe. *Lancet*, 2006, 368:2243–50.
6. McKee M, Jacobson B. Public health in Europe. *Lancet*, 2000, 356.
7. Menne B et al., eds. *Protecting health in Europe from climate change*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Publications/Catalogue/20080403_1, accessed 19 November 2008).
8. Racioppi F et al. *Preventing road traffic injury: a public health perspective for Europe*. Copenhagen, WHO Regional Office for Europe, 2004 (http://www.euro.who.int/InformationSources/Publications/Catalogue/20041119_2, accessed 10 November 2008).
9. Stirbu I et al. Injury mortality among ethnic minority groups in the Netherlands. *Journal of Epidemiology and Community Health*, 2006, 60:249–255.
10. Tamburlini G. Children's special vulnerability to environmental health hazards: an overview. In: Tamburlini G, von Ehrenstein O, Bertollini R, eds. *Children's health and environment: a review of evidence*. Copenhagen, European Environment Agency, 2002 (Environmental Issue Report 29).
11. Aynsley-Green A et al. Who is speaking for children and adolescents and for their health at policy level. *BMJ*, 2000, 321:229–232.
12. Bartlett S. Children's experience of the physical environment in poor urban settlements and the implications for policy, planning and practice. *Environment & Urbanization*, 1999, 11:63–73.
13. *Convention on the Rights of the Child*. New York, United Nations, 1989 (http://www.un.org/millennium/law/iv-10.htm, accessed 19 November 2008).
14. Youth Declaration for Road Safety [web site]. Geneva, World Health Organization, 2008 (http://www.who.int/roadsafety/week/activities/global/youth/declaration/en/index.html, accessed 19 November 2008).
15. Jensen B, et al. *Young people want to be part of the answer*. Copenhagen, European Network of Health Promoting Schools Secretariat, WHO Regional Office for Europe for Europe, 2005.
16. Children's Environment and Health Action Plan for Europe (CEHAPE) [web site]. Copenhagen, WHO Regional Office for Europe, 2002 (http://www.euro.who.int/childhealthenv/policy/20020724_2, accessed 28 October 2008).
17. UNICEF, WHO. *Companion to the World Report on Child Injury Prevention 2008 Have Fun, Be Safe*. New York, United Nations Children's Fund (in press).
18. Pearson G, ed. *Why children die: a pilot study 2006, England (South West, North East and West Midlands, Wales and Northern Ireland)*. London, Confidential Enquiry into Maternal and Child health, 2008.
19. *Why children die: a pilot study 2006. Children and young people's report*. London, National Children's Bureau, 2008 (http://www.cemach.org.uk/getattachment/c77d8563-8795-442e-a998-f4aaef0cfe68/Why-Children-Die--, accessed 19 November 2008).
20. *Making London better for all children. The Major's children and young people's strategy*. London, Mayor of London, 2004 (http://www.london.gov.uk/mayor/strategies/children/docs/main.pdf, accessed 19 November 2008).
21. Sethi D et al. *Injuries and violence in Europe: why they matter and what can be done*. Copenhagen, WHO Regional Office for Europe, 2006 (http://www.euro.who.int/document/E88037.pdf, accessed 28 October 2008).
22. Marmot M. Social determinants of health: inequalities. *Lancet*, 2005, 365:347-353.
23. Zwi A. Injuries, inequalities and health: from policy vacuum to policy action. In: Leon D, Walt G, eds. *Poverty, inequality and health*. Oxford, Oxford University Press, 2002:263–282.
24. *Closing the gap in a generation: health equity through action on the social determinants of health*. Final Report of the Commission on Social Determinants of Health. Geneva, World Health Organization, 2008 (http://whqlibdoc.who.int/publications/2008/9789241563703_eng.pdf, accessed 19 November 2008).
25. Pless I, Towner E. Practitioners and policy-makers. In: Aynsley-Green A et al., eds. *Unintentional injury in childhood and adolescence*. London, Bailliere Tindall, 1997:393–409.
26. Elvik R, Vaa T. *Handbook of road safety measures*. London, Elsevier Ltd, 2004.
27. *Cost effective EU transport safety measures*. Brussels, European Transport Safety Council, 2003.
28. Miller T, Levy D. Cost-outcome analysis in injury prevention and control: eighty-four recent estimates for the United States. *Medical Care*, 2000, 38:562–582.
29. *Cost–benefit analysis of measures for vulnerable road users*. Amsterdam, Institute for Road Safety Research (SWOV), 2001 (http://www.swov.nl/rapport/promising/wp5final.pdf, accessed 19 November 2008).
30. Whitehead M. Diffusion of ideas on social inequalities in health: a European perspective. *Milbank Quarterly*, 1998, 76:469–492.
31. *Socioeconomic differences in injury risks. A review of findings and discussion of potential counter measures*. Copenhagen, WHO European Regional Office (in press).
32. *World Health Assembly resolution WHA57.10 on road safety and health*. Geneva, World Health Organization, 2004 (http://policy.who.int/cgi-bin/om_isapi.dll?advquery= WHA57.10andinfobase=whaandrecord={ 11BDA}andsoftpage=Browse_Frame_Pg42andzz=, accessed 28 October 2008).
33. *WHO Regional Committee for Europe resolution EUR/RC55/R9 on prevention of injuries in the WHO European Region*. Copenhagen, WHO Regional Office for Europe, 2005 (http://www.euro.who.int/eprise/main/WHO/AboutWHO/Governance/resolutions/2005/20050922_1, accessed 28 October 2008).
34. *Consultation of the Member States on elements for a proposal for a Commission Communication and Council recommendation on injury prevention and safety promotion*. Luxembourg: European Commission, 2001 (http://www.eu.int/comm/health/ph_determinants/environment/IPP/ev_20051012_en.htm, accessed 28 October 2008).
35. Sethi D et al. *Progress in preventing injuries in the WHO European Region*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/InformationSources/Publications/20080925_11, accessed 19 November 2008).
36. *The Tallinn Charter: Health Systems for Health and Wealth*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/document/E91438.pdf, accessed 28 October 2008).
37. *WHO Regional Committee for Europe resolution RC58/R9 on stewardship/Governance of health systems in the WHO European Region*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/Document/RC58/RC58_edoc09.pdf, accessed 13 November 2008).
38. Child and adolescent health and development. Strategy [web site]. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/childhealtdev/strategy/20060919_1, accessed 19 November 2008).

39. *TEACH-VIP. Users guide*. Geneva, World Health Organization, 2005 (http://www.who.int/violence_injury_prevention/capacitybuilding/teach_vip/en/index.html, accessed 19 November 2008).
40. *MENTOR-VIP, Skills development*. Geneva, World Health Organization, 2007 (http://www.who.int/violence_injury_prevention/capacity_building/mentor_vip/en, accessed 19 November 2008).
41. MacKay M, Vincenten J. *Child safety summary report card for 18 countries – 2007*. Amsterdam, European Child Safety Alliance, 2007.
42. Shields N et al. *National responses to preventing violence and unintentional injuries*. Copenhagen, WHO Regional Office for Europe, 2006 (http://www.euro.who.int/document/e89258.pdf, accessed 19 November 2008).

ANNEX 1
DATA SOURCES

WHO European mortality databases

The WHO Regional Office for Europe developed the European detailed mortality database (DMDB) and the European mortality database (HFA-MDB), supplementing the generic European Health for All database (HFA-DB). Mortality indicators in the HFA-MDB are presented for 67 selected causes or groups of causes of death, defined by age groups. Member States submit raw data to the WHO Regional Office for Europe or WHO headquarters. Member States report official mortality data according to the 9th and 10th revision of the International Statistical Classification of Diseases and Health Related Problems (ICD) *(1)*. Table 1 shows the ICD codes used for the external causes of injury. Data available in these databases are from 1979 onwards.

The HFA-MDB has the advantage of having consistent, longer time series and coverage while the DMDB can provide more specific information. For the purposes of this report, data were downloaded for the years 2003–2005 (or the most recent three years). Data from the DMDB are available in five-year age bands, and age-standardized mortality rates were calculated for the 0- to 19-year age group. Although the United Nations defines children as being from 0 to 17 years, this breakdown of the data is not available from this source, and the age band 0–19 years was used instead. In the HFA-MDB, age-standardized trend data are available for the age group 0–19 years from 1979 onwards and are presented in this report. Raw mortality data from the DMDB were used for calculating mortality rates from unintentional injury in children. The use of the standardized calculation methods and denominators allows comparison between countries and further detailed statistical elaborations.

Table 1
External causes of injury and their corresponding ICD codes

Type of injury	Code		
	ICD-9	ICD-9 BTL	ICD-10
All injuries	E800–E999	B47–B56	V01–Y98
Unintentional injuries	E800–E949	B47–B53	V01–X59, Y40–Y86, Y88, Y89
Road traffic injuries	E810–E819, E826–E829, E929	B471–B472	V01–V89, V99, Y850
Poisoning	E850–E869	B48	X40–X49
Falls	E880–E888	B50	W00–W19
Fires	E890–E899	B51	X00–X09
Drowning	E910	B521	W65–W74
Other unintentional injuries[a]	E800–E807, E820–E848, E870–E879, E900–E909, E911–E949	B49, B52 (excluding B521), B53, B47 (excluding B560)	V90–V98, W20–W64, W75–W99, X10–X39, X50–X59, Y40–Y86, Y88, Y89

[a] The DMDB does not differentiate between other unintentional injuries and all other injuries (including intentional injuries). Since intentional injuries comprise less than 2% of total injuries and because of the way they are collated on the detailed mortality database, all other injuries have been assumed to be unintentional.

United Nations Economic Commission for Europe transport database

The United Nations Economic Commission for Europe (UNECE) annually collects data on road traffic crashes resulting in death or injury, based on replies submitted by Member States and official national and international sources *(2)*. Of the UNECE's 55 Member States, 52 are Member States of WHO in the European Region. Data for Liechtenstein are consolidated with those for Switzerland. These data are available for the age groups 0–9 and 10–17 years and have been presented accordingly.

WHO Global Burden of Disease, 2004 update

WHO Global Burden of Disease analysis provides a comprehensive and comparable assessment of mortality and loss of health due to diseases, injuries and risk factors for all regions of the world. The overall burden of disease is assessed using the disability-adjusted life-year (DALY), a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health. The WHO Global Burden of Disease project draws on a wide range of data sources to develop internally consistent national, regional and global estimates for more than 130 major diseases. WHO participation in developing and finalizing these estimates ensures that estimates reflect all information and knowledge available to WHO. The latest assessment of the Global Burden of Disease for 2004, which includes revisions, new data and methods, was published in 2008 *(3)*.

APOLLO Hospital Discharge Database

The APOLLO Hospital Discharge Database *(4)* is part of a project partly funded by the European Commission within the current European Union Public Health Programme. It is a web-based query passive surveillance system based on patient-level hospital discharge data from 17 voluntarily participating countries.

This report included hospital discharge cases with at least one injury diagnosis. Eligible injury diagnoses based on the tenth or ninth revisions of the International Statistical Classification of Diseases and Related Health Problems (ICD) *(1)* were ICD-10 S00.0–T98.3 (excluding T36.0–T39.9, T41.0–T50.9 and T80–T88) or ICD-9 N codes 800–909.2, 909.4, 909.9–994.9, 995.5–995.59 and 995.80–995.85. Unintentional injuries were identified using the respective coding for injury mechanism or cause, and age-standardized admission rates were calculated. Data for the year 2004 (or the most recent year) are presented. Despite standardization procedures, hospital discharge data participating countries collected for administrative purposes may not be directly comparable. This relates to a variety of factors, such as differences in hospitalization practices, health financing and completeness of coding practices *(5)*.

Eurocosts

Part of the APOLLO project, Eurocosts uses a uniform method and a software application to derive the direct health care costs of injuries treated in emergency departments and/or admitted to hospitals and indirect costs of these injuries for selected countries. Unit costs (cost per injury) are combined with incidence data to derive population-based costs. However, the unit costs are not specific to intentional or unintentional injuries, nor are they age- or sex-specific *(6)*.

Classification of countries in the WHO European Region by income per capita

Economies are categorized by income level according to 2004 gross national income per capita, calculated using the World Bank Atlas method *(7)*. Based on gross national income per capita in 2007, economies are classified as low income (US$ 935 or less), middle income (US$ 936 to US$ 11 455) and high income (US$ 11 456 or more). For the Global Burden of Disease 2004 study, countries are divided into high-income countries and low- and middle-income countries (Table 2).

Table 2
Categorization of countries in the WHO European Region by gross national income per capita, 2004

Low- and middle-income countries (n = 28)	High-income countries (n = 25)
Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Montenegro, Poland, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, Uzbekistan	Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom

Source: World Bank *(7)*.

European Union countries

Austria, Belgium, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

Commonwealth of Independent States (CIS)

Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan (associate member), Ukraine and Uzbekistan.

Geographical classification by subregion

Countries are associated in a practical way by geographical subregions. Underlying considerations are that countries in the same geographical area often have similar health conditions and similar trends in mortality. Classification by geographical area is as follows:

- Nordic countries: Denmark, Finland, Iceland, Norway and Sweden;
- western European countries: Austria, Belgium, France, Germany, Ireland, Luxembourg, Netherlands, Switzerland and United Kingdom;
- southern European countries: Greece, Israel, Italy, Malta, Portugal and Spain;
- central European countries: Czech Republic, Hungary, Poland, Slovakia and Slovenia;
- south-eastern European countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Montenegro, Romania, Serbia and The former Yugoslav Republic of Macedonia;
- Baltic countries: Estonia, Latvia and Lithuania;
- north-western CIS countries: Belarus, Georgia, Republic of Moldova, Russian Federation and Ukraine;
- southern CIS countries: Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

References

1. *International Statistical Classification of Diseases and Related Health Problems*. Tenth revision. Geneva, World Health Organization, 1992 (http://www.who.int/classifications/apps/icd/icd10online, accessed 21 November 2008).
2. United Nations Economic Commission for Europe transport database [online database]. Geneva, United Nations Economic Commission for Europe, 2008 (http://w3.unece.org/pxweb/Dialog, accessed 21 November 2008).
3. *The global burden of disease: 2004 update*. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).
4. APOLLO Hospital Discharge Database [online database]. Navarre, University of Navarre, 2008 (https://www.unav.es/ecip/apollo/asistente).
5. Segui-Gomez M. *Injury-related hospitalizations in Europe, 2004*. Navarre, European Center for Injury Prevention, 2008.
6. Polinder S et al. *APOLLO: the economic consequences of injury. Final report*. Amsterdam, Consumer Safety Institute, 2008.
7. Country classification [web site]. Washington, DC, World Bank, 2008 (http://go.worldbank.org/K2CKM78CC0, accessed 21 November 2008).

ANNEX 2
METHODS

Standardized mortality rates and rate ratios

Mortality data by age and sex provide a convenient and essential measure of disease or injury estimates of lives lost. The first analytical step in any estimation of the burden of disease or injury is to assess the age-specific death rates, by sex, for a given population for the reference year chosen for the study. This last should be chosen to be the most recent year for which data are available and might coincide with the census year or one for which extensive epidemiological and demographic data are accessible from other sources *(1)*. In this report, two mortality indicators were calculated for further analysis:

1. Age-specific crude mortality rates (CDR) were calculated as follows:

$$CDR = \frac{D_i}{P_i}$$, with D = deaths; P = population; and i = age group.

2. Standardized mortality rates use a set of weights from a standard population, the reference population (European or world population structure) to compare different mortality profiles inside the WHO European Region. The formula is as follows *(1)*:

$$\sum_{i=0}^{N} \frac{D_i}{P_i} \times W_i$$, with D = deaths; P = population; i = age group; and N = last age group;

$$\text{W = weight } = \frac{\text{Reference population}_i}{\text{Total reference population}_i}$$

Age-standardized rates were calculated using the direct method and the European standard population structure (Table 1).

Table 1
European standard population weights

Age (years)	<1	1–4	5–9	10–14	15–19
Weight	0.016	0.064	0.07	0.07	0.07

Source: WHO European detailed mortality database (DMDB), update November 2007. Copenhagen, WHO Regional Office for Europe.

As deaths from injury may be rare, a three-year average was used to increase reliability. Similarly, countries with a population of less than 1 million were excluded from the calculation: Andorra, Cyprus, Iceland, Luxembourg, Malta, Monaco, Montenegro and San Marino. Charts were constructed in order of rank.

Children's lives lost and estimated potential lives saved

The number of potential lives saved was calculated using country-level data derived from the European detailed mortality database. This estimate measures the potential lives saved if all countries had the same standardized mortality rate as the one with the lowest rate in the European Region. The countries with the lowest rates for each injury mechanism were used: Sweden for falls and road traffic injury, Switzerland for fire, Denmark for poisoning, the United Kingdom for drowning and Netherlands for all other unintentional injury deaths. Estimated mortality rates were calculated by applying age-specific

rates to the respective age band of each country available on the WHO European detailed mortality database using a method described previously *(2)*. In selecting countries with the lowest rate, only those with reliable data and a population exceeding 5 million were considered. The calculation was performed for children aged 0–19 years for an average of a three-year period (2003–2005 or the most recent three years available). Table 2 shows the results for individual countries.

Limitations of mortality datasets

The European mortality databases have data for all 53 Member States in the WHO European Region. However, the comparability between countries may be limited due to differences in classification systems, completeness, accuracy and recording practices. Some countries have had problems with precise mortality data since the 1990s caused by severe socioeconomic difficulties and armed conflicts. This is especially true for some of the countries in central Asia (such as Tajikistan), in the Caucasus (such as Azerbaijan and Georgia), and in the Balkan region (such as Albania and Bosnia and Herzegovina). Mortality data are not available for Turkey. Only the countries with the most reliable data were used for comparing standardized mortality rates between countries in rank and calculating death rate ratios (WHO European detailed mortality database).

References

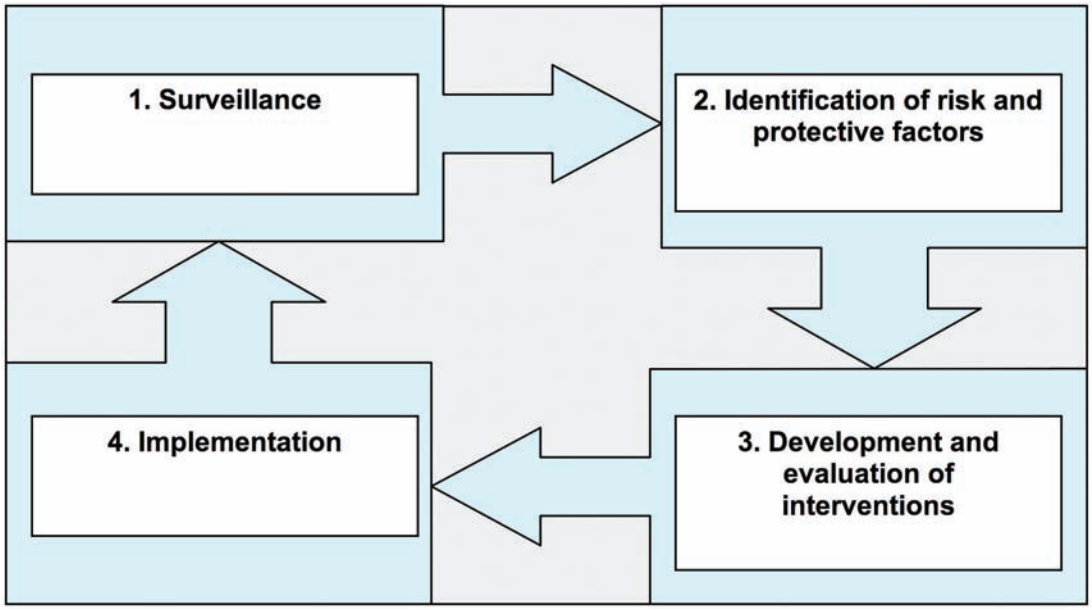
1. Mathers C et al. *Global Burden of Disease 2000: version 2 methods and results*. Geneva, World Health Organization, 2002 (GPE Discussion Paper, No. 50; http://www3.who.int/whosis/discussion_papers/pdf/paper50.pdf, accessed 21 November 2008).
2. Adamson P, Micklewright J, Wright A. *A league table of child deaths by injury in rich countries*. Florence, UNICEF Innocenti Research Centre, 2001 (Innocenti Report Card Issue No. 2).

ANNEX 3
CONCEPTUAL APPROACHES TO INJURY PREVENTION

The public health approach

One of the models this report promotes is the public health approach to injury prevention. This is a systematic process following the four logical steps illustrated in Figure 1. The first is surveillance: finding out the extent of the problem, where it occurs and whom it affects. Second, risk factors are identified to understand why a certain group of people is at risk. Step three is to develop and evaluate interventions to find out what works, and step four, the wide implementation of proven strategies *(1,2)*. The advantage of this approach is that it subjects injury prevention to concrete measures involving actors from different agencies and organizations rather than leaving it to chance.

Figure 1
The public health approach to preventing injury



Haddon's matrix

The Haddon matrix fits very well with the public health approach to prevention in which primary prevention corresponds to preventing injuries, secondary prevention to mitigating the effects of exposure to excess energy during the incident and tertiary prevention means providing post-injury care *(3,4)*. This corresponds to the epidemiological triad of human, mechanical and environmental factors that can interact in each phase of the incident. It led to 10 strategies for preventing and controlling injury (Box 1). The matrix is useful in identifying risk factors and interventions for controlling injury and emphasizes a multisectoral approach to prevention. Recent developments in injury prevention have used this matrix, and interventions have traditionally been considered in terms of the "three E's": (1) engineering and product design or modification; (2) enforcement of legislation and policies; and (3) education of a range of stakeholders including individuals, practitioners, policy-makers and community members. This has since been expanded to include evaluation of programmes, the evidence base and the economics of what works.

Box 1

Haddon's 10 strategies for preventing and controlling injury

1. Eliminate the hazard
2. Separate the hazard
3. Isolate the hazard
4. Modify the hazard
5. Equip the child
6. Train and instruct the child or carer
7. Warn the child or carer
8. Supervise the child
9. Rescue the child
10. Treat and rehabilitate the child

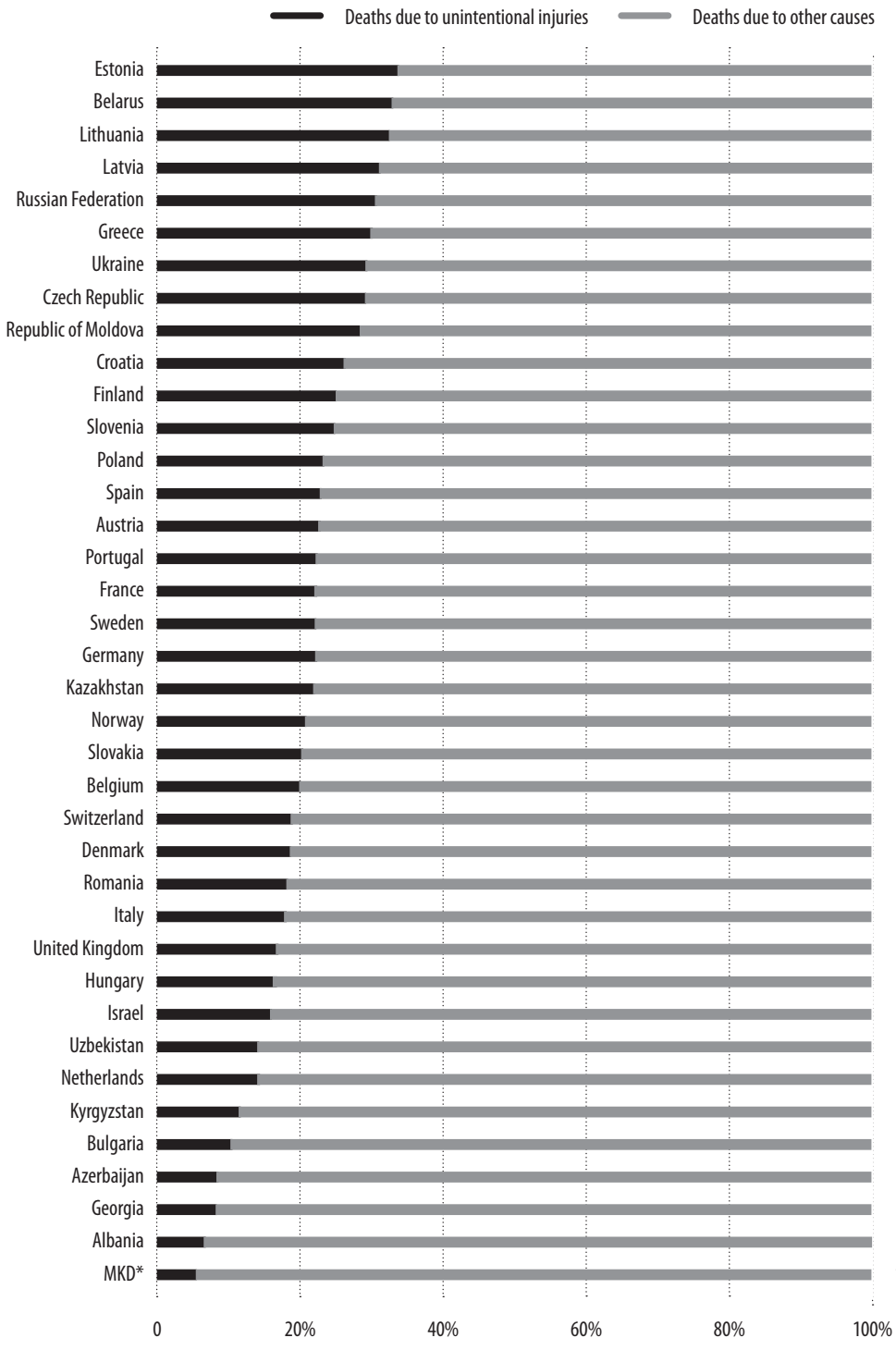
Source: Haddon *(4)*.

References

1. Peden M et al. *World report on child injury prevention*. Geneva, World Health Organization, 2008.
2. Sethi D et al. *Injuries and violence in Europe: why they matter and what can be done*. Copenhagen, WHO Regional Office for Europe, 2006 (http://www.euro.who.int/document/E88037.pdf, accessed 21 November 2008).
3. Haddon W. Energy damage and the ten countermeasure strategies. *Journal of Trauma*, 1973, 13:321–331.
4. Haddon W. The basic strategies for preventing damage from hazards of all kinds. *Hazard Prevention*, 1980, 16:8–11.

ANNEX 4
ADDITIONAL RESULTS

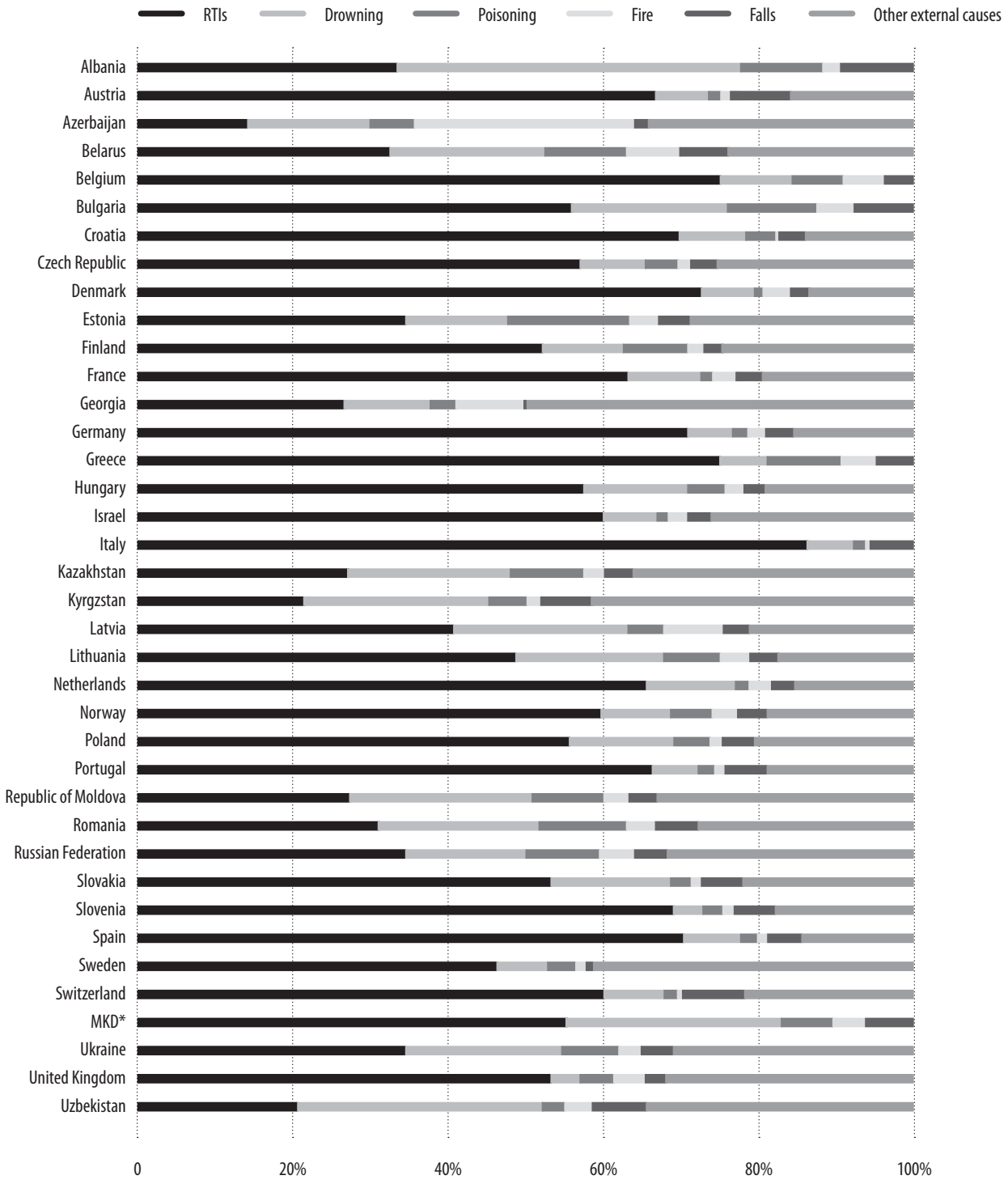
Figure 1
Deaths caused by unintentional injuries as a proportion of all deaths among children and adolescents aged 0–19 years in countries of the WHO European Region (2003–2005 or last available)



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.

Figure 2

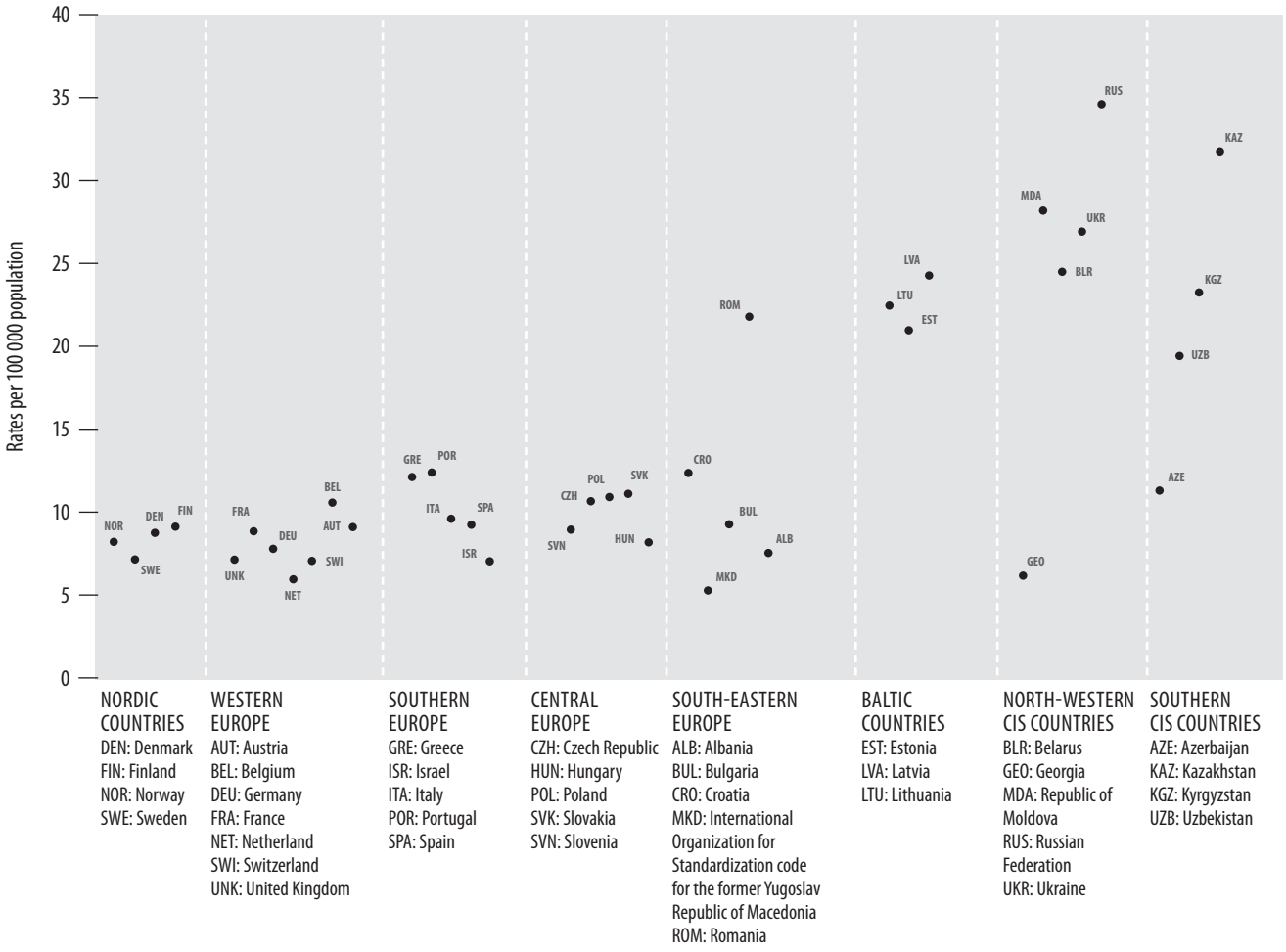
Estimated proportion of deaths by unintentional injury by cause of injury among children and adolescents aged 0–19 years in the WHO European Region (2003–2005 or last available)



*International Organization for Standardization code for the former Yugoslav Republic of Macedonia.
Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.

Figure 3

Fig. 3. Average annual standardized mortality rates of all unintentional injuries among children and adolescents aged 0–19 years, by subregion, 2003–2005 or last available three years



NORDIC COUNTRIES
DEN: Denmark
FIN: Finland
NOR: Norway
SWE: Sweden

WESTERN EUROPE
AUT: Austria
BEL: Belgium
DEU: Germany
FRA: France
NET: Netherland
SWI: Switzerland
UNK: United Kingdom

SOUTHERN EUROPE
GRE: Greece
ISR: Israel
ITA: Italy
POR: Portugal
SPA: Spain

CENTRAL EUROPE
CZH: Czech Republic
HUN: Hungary
POL: Poland
SVK: Slovakia
SVN: Slovenia

SOUTH-EASTERN EUROPE
ALB: Albania
BUL: Bulgaria
CRO: Croatia
MKD: International Organization for Standardization code for the former Yugoslav Republic of Macedonia
ROM: Romania

BALTIC COUNTRIES
EST: Estonia
LVA: Latvia
LTU: Lithuania

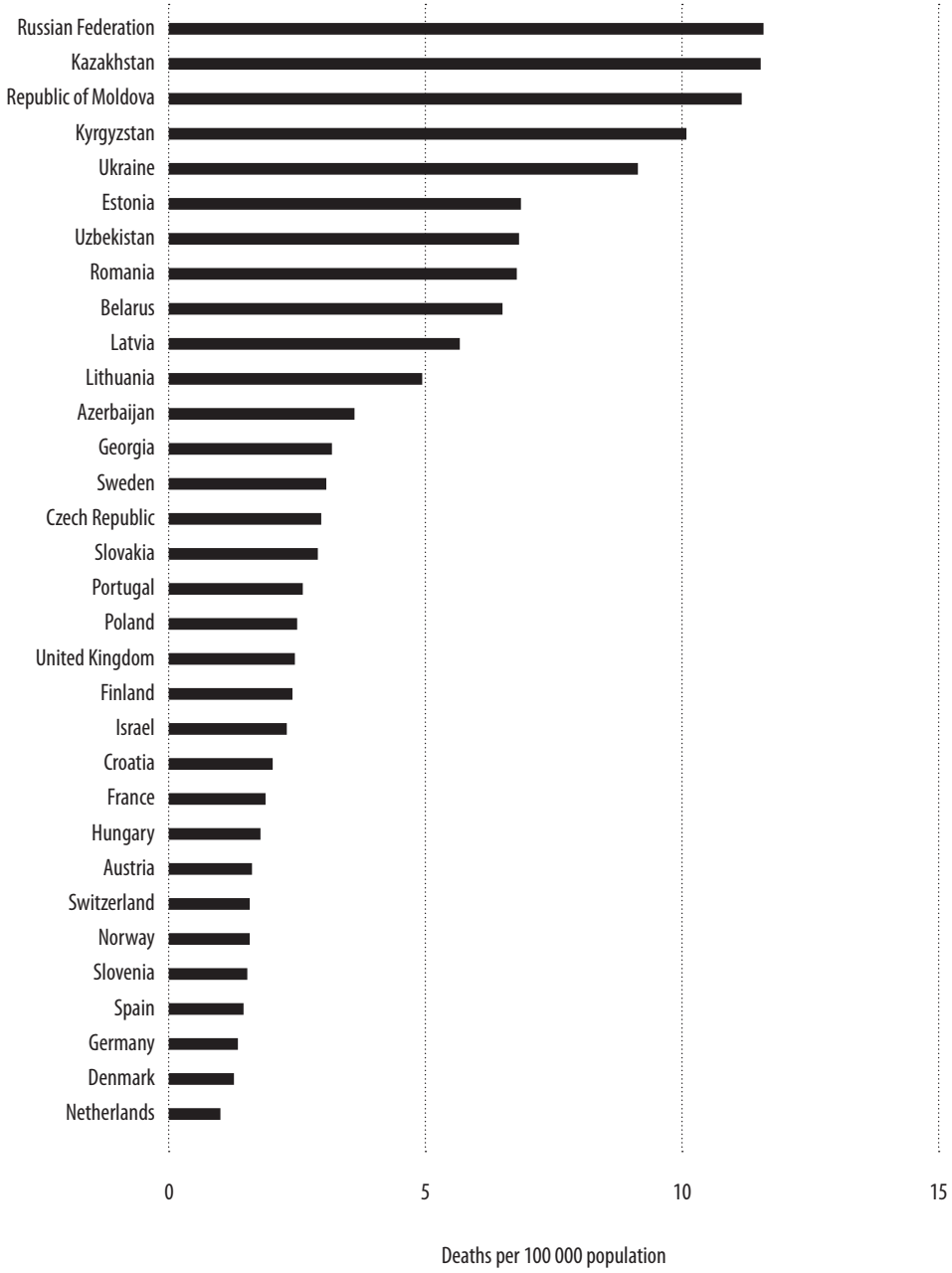
NORTH-WESTERN CIS COUNTRIES
BLR: Belarus
GEO: Georgia
MDA: Republic of Moldova
RUS: Russian Federation
UKR: Ukraine

SOUTHERN CIS COUNTRIES
AZE: Azerbaijan
KAZ: Kazakhstan
KGZ: Kyrgyzstan
UZB: Uzbekistan

Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.

Figure 4

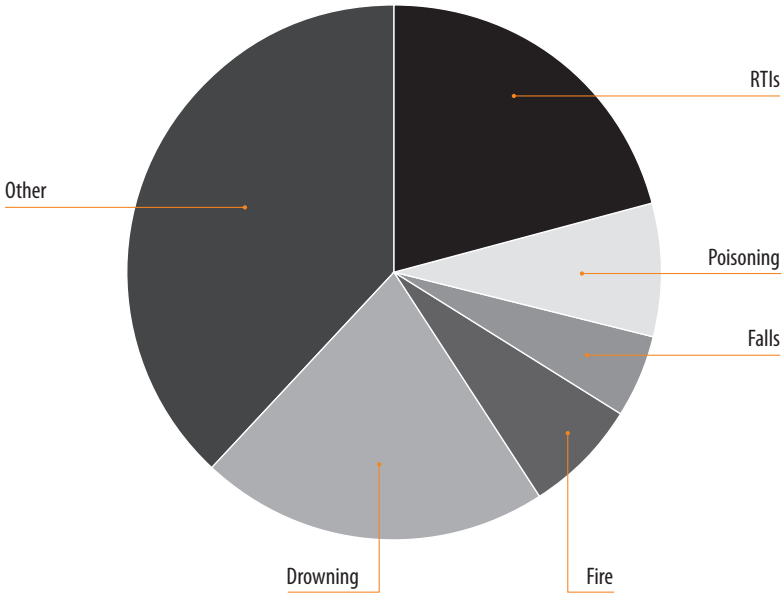
Average annual standardized mortality rates for all other unintentional injury causes among children and adolescents aged 0–19 years in the WHO European Region, 2003–2005 or most recent three years



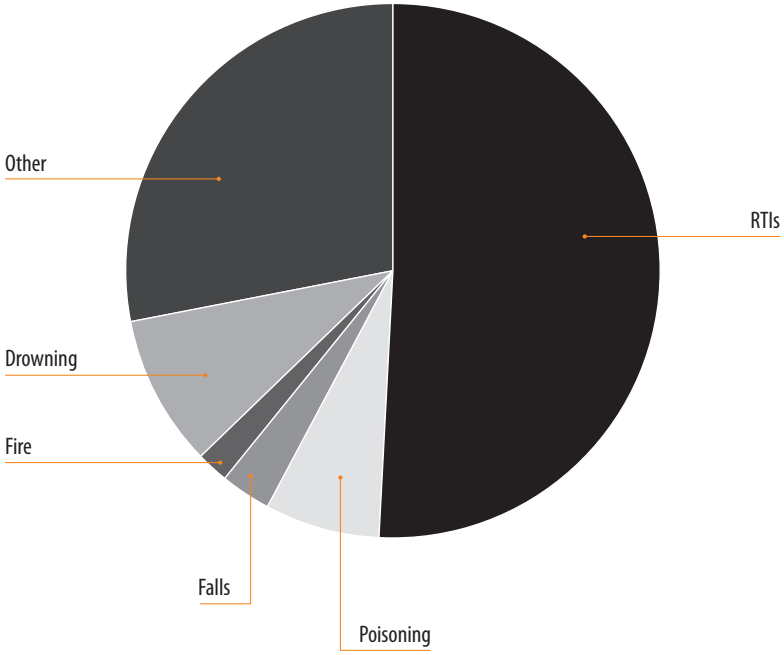
Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.

Figure 5

Proportion of injury deaths among children and adolescents by injury cause and age group in the WHO European Region



GROUP AGED **0–9 YEARS**



GROUP AGED **10–19 YEARS**

Source: *The global burden of disease: 2004 update.* Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

Table 1

Rank of 15 leading causes of death among children and adolescents 0–19 years old by age group in the WHO European Region

Rank	<1 year	1–4 years	5–9 years	10–14 years	15–19 years	<20 years
1	Perinatal causes	Lower respiratory infections	Road traffic injuries	Road traffic injuries	Road traffic injuries	Perinatal causes
2	Lower respiratory infections	Diarrhoeal diseases	Drowning	Drowning	Self-inflicted injuries	Lower respiratory infections
3	Diarrhoeal diseases	Congenital anomalies	Lower respiratory infections	Self-inflicted injuries	Violence	Diarrhoeal diseases
4	Congenital anomalies	Drowning	Leukaemia	Leukaemia	Leukaemia	Congenital anomalies
5	Meningitis	Meningitis	Congenital anomalies	Lower respiratory infections	Poisoning	Road traffic injuries
6	Upper respiratory infections	Road traffic injuries	Lymphomas, multiple myeloma	Congenital anomalies	Drowning	Self-inflicted injuries
7	Endocrine disorders	Fires	Upper respiratory infections	Lymphomas, multiple myeloma	Cerebrovascular disease	Meningitis
8	HIV/AIDS	Poisoning	Cerebrovascular disease	Violence	Congenital anomalies	Drowning
9	Hepatitis B	HIV/AIDS	Epilepsy	Epilepsy	Epilepsy	Leukaemia
10	Inflammatory heart diseases	Leukaemia	Endocrine disorders	Endocrine disorders	Lower respiratory infections	Violence
11	Violence	Endocrine disorders	Self-inflicted injuries	Falls	HIV/AIDS	Upper respiratory infections
12	Asthma	Upper respiratory infections	Poisoning	Poisoning	Lymphomas, multiple myeloma	Poisoning
13	Iron-deficiency anaemia	Falls	Violence	Cerebrovascular disease	Nephritis and nephrosis	Endocrine disorders
14	Road traffic injuries	Hepatitis B	Fires	War and conflict	Cirrhosis of the liver	HIV/AIDS
15	Epilepsy	Epilepsy	Falls	Nephritis and nephrosis	Ischaemic heart disease	Epilepsy

Source: *The global burden of disease: 2004 update*. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

The five types of unintentional injuries causing the most deaths among children and adolescents 0–19 years old are emphasized in shaded boxes.

Table 2

Age-standardized mortality rates per 100 000 population from unintentional injury among children and adolescents 0–19 years old by age group and injury type, with rate ratios for high-income countries (HIC) versus low- and middle-income countries (LMIC) in the WHO European Region

		<1 year	1–4 years	5–9 years	10–14 years	15–19 years	0–19 years
All unintentional injuries	HIC	6.49	4.80	2.99	3.86	18.78	7.93
	LMIC	66.43	31.82	15.76	13.95	32.71	25.38
	Rate ratio	10.23	6.62	5.27	3.61	1.74	3.20
Road traffic injuries	HIC	1.19	1.30	1.43	2.24	14.75	5.15
	LMIC	6.34	4.64	5.49	4.65	15.83	8.30
	Rate ratio	5.34	3.57	3.83	2.07	1.07	1.61
Poisoning	HIC	0.04	0.08	0.05	0.09	0.64	0.22
	LMIC	5.50	3.39	0.82	0.77	2.75	2.04
	Rate ratio	140.00	42.94	17.31	8.89	4.31	9.23
Falls	HIC	0.34	0.45	0.16	0.21	0.49	0.32
	LMIC	2.92	1.68	0.62	0.72	0.81	0.98
	Rate ratio	8.52	3.75	4.00	3.47	1.65	3.06
Fire	HIC	0.25	0.39	0.13	0.16	0.16	0.20
	LMIC	3.10	3.52	0.68	0.43	0.44	1.12
	Rate ratio	12.53	8.92	5.15	2.75	2.71	5.58
Drowning	HIC	0.48	1.09	0.39	0.23	0.68	0.56
	LMIC	1.83	9.30	3.83	3.12	2.12	3.95
	Rate ratio	3.85	8.53	9.77	13.65	3.11	7.00
Other unintentional injuries	HIC	4.20	1.49	0.83	0.94	2.05	1.47
	LMIC	46.75	9.29	4.31	4.26	10.76	8.98
	Rate ratio	11.12	6.21	5.20	4.54	5.24	6.10

Source: *The global burden of disease: 2004 update*. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

Table 3

The 15 leading causes of mortality and loss of disability-adjusted life-years (DALYs) among children younger than 15 years by sex and income level in the WHO European Region, 2004

??????????????????

BOTH SEXES <15 years

Rank	Cause of death	Proportion of total (%)
1	Perinatal causes	33.2
2	Lower respiratory infections	13.8
3	Diarrhoeal diseases	12.4
4	Congenital anomalies	10.3
5	Road traffic injuries	2.2
6	Meningitis	2.2
7	Drowning	1.9
8	Upper respiratory infections	1.3
9	Leukaemia	1.0
10	Endocrine disorders	0.8
11	HIV/AIDS	0.7
12	Poisoning	0.6
13	Fire-related burns	0.6
14	Epilepsy	0.5
15	Violence	0.5

Rank	Cause of loss of DALYs	Proportion of total (%)
1	Perinatal causes	21.6
2	Congenital anomalies	9.8
3	Lower respiratory infections	7.5
4	Diarrhoeal diseases	7.1
5	Iodine deficiency	4.0
6	Unipolar depressive disorders	3.1
7	Asthma	2.7
8	Falls	2.2
9	Road traffic injuries	1.9
10	Refractive errors	1.7
11	Migraine	1.7
12	Endocrine disorders	1.5
13	Schizophrenia	1.4
14	Meningitis	1.4
15	Iron-deficiency anaemia	1.3

BOYS <15 years

Rank	Cause of death	Proportion of total (%)
1	Perinatal causes	33.5
2	Lower respiratory infections	13.4
3	Diarrhoeal diseases	11.9
4	Congenital anomalies	10.1
5	Road traffic injuries	2.5
6	Drowning	2.2
7	Meningitis	2.0
8	Upper respiratory infections	1.2
9	Leukaemia	1.0
10	Endocrine disorders	0.8
11	Poisoning	0.6
12	HIV/AIDS	0.6
13	Fire-related burns	0.6
14	Self-inflicted injuries	0.5
15	Epilepsy	0.5

Rank	Cause of loss of DALYs	Proportion of total (%)
1	Perinatal causes	21.8
2	Congenital anomalies	9.7
3	Lower respiratory infections	7.5
4	Diarrhoeal diseases	7.0
5	Iodine deficiency	3.5
6	Falls	2.7
7	Unipolar depressive disorders	2.6
8	Asthma	2.3
9	Road traffic injuries	2.0
10	Refractive errors	1.6
11	Schizophrenia	1.5
12	Endocrine disorders	1.4
13	Meningitis	1.3
14	Drowning	1.3
15	Iron-deficiency anaemia	1.2

GIRLS <15 years					
Rank	Cause of death	Proportion of total (%)	Rank	Cause of loss of DALYs	Proportion of total (%)
1	Perinatal causes	32.8	1	Perinatal causes	21.2
2	Lower respiratory infections	14.3	2	Congenital anomalies	10.0
3	Diarrhoeal diseases	12.9	3	Lower respiratory infections	7.5
4	Congenital anomalies	10.6	4	Diarrhoeal diseases	7.2
5	Meningitis	2.4	5	Iodine deficiency	4.6
6	Road traffic injuries	1.9	6	Unipolar depressive disorders	3.7
7	Upper respiratory infections	1.4	7	Asthma	3.1
8	Drowning	1.3	8	Migraine	2.3
9	Leukaemia	1.0	9	Refractive errors	1.9
10	Endocrine disorders	0.9	10	Road traffic injuries	1.7
11	HIV/AIDS	0.8	11	Endocrine disorders	1.6
12	Poisoning	0.7	12	Falls	1.4
13	Fire-related burns	0.6	13	Iron-deficiency anaemia	1.4
14	Epilepsy	0.5	14	Meningitis	1.4
15	Violence	0.5	15	Schizophrenia	1.3

EUROPEAN REGION

HIGH-INCOME COUNTRIES, BOTH SEXES <15 years					
Rank	Cause of death	Proportion of total (%)	Rank	Cause of loss of DALYs	Proportion of total (%)
1	Perinatal conditions	38.4	1	Perinatal conditions	16.7
2	Congenital anomalies	23.0	2	Congenital anomalies	15.1
3	Road traffic injuries	4.1	3	Asthma	8.0
4	Endocrine disorders	3.6	4	Unipolar depressive disorders	7.3
5	Leukaemia	2.3	5	Endocrine disorders	4.3
6	Lower respiratory infections	1.4	6	Schizophrenia	3.6
7	Meningitis	1.3	7	Refractive errors	3.6
8	Drowning	1.3	8	Migraine	3.3
9	Violence	1.0	9	Dental caries	2.4
10	Inflammatory heart diseases	0.9	10	Falls	2.1
11	Epilepsy	0.9	11	Road traffic injuries	2.0
12	Falls	0.6	12	Diarrhoeal diseases	1.4
13	Cerebrovascular disease	0.6	13	Otitis media	1.1
14	Fire-related burns	0.5	14	Iron-deficiency anaemia	1.1
15	Self-inflicted injuries	0.4	15	Epilepsy	1.1

LOW- AND MIDDLE-INCOME COUNTRIES, BOTH SEXES <15 years					
Rank	Cause of death	Proportion of total (%)	Rank	Cause of loss of DALYs	Proportion of total (%)
1	Perinatal causes	32.6	1	Perinatal causes	22.5
2	Lower respiratory infections	15.2	2	Lower respiratory infections	9.0
3	Diarrhoeal diseases	13.7	3	Congenital anomalies	8.6
4	Congenital anomalies	8.8	4	Diarrhoeal diseases	8.3
5	Meningitis	2.3	5	Iodine deficiency	4.9
6	Road traffic injuries	2.0	6	Falls	2.2
7	Drowning	1.9	7	Unipolar depressive disorders	2.1
8	Upper respiratory infections	1.4	8	Road traffic injuries	1.8
9	Leukaemia	0.9	9	Asthma	1.5
10	HIV/AIDS	0.7	10	Meningitis	1.4
11	Poisoning	0.7	11	Iron-deficiency anaemia	1.4
12	Fire-related burns	0.6	12	Migraine	1.4
13	Endocrine disorders	0.5	13	Refractive errors	1.3
14	Self-inflicted injuries	0.5	14	Protein-energy malnutrition	1.3
15	Epilepsy	0.5	15	Drowning	1.2

Source: *The global burden of disease: 2004 update*. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

Table 4

Average annual number of deaths from unintentional injuries among children and adolescents aged 0–19 years in countries of the WHO European Region, 2003–2005 or the latest three years

Country	Years studied	Number of deaths by cause						
		Falls	Fire	Poisoning	RTIs	Drowning	Other unintentional injury	Total number of deaths
Albania	1999–2001	9	2	10	32	42	Data missing	96
Austria	2003–2005	13	2	2	116	12	29	174
Azerbaijan	2001–2002	7	96	19	49	53	116	338
Belarus	2002–2003	40	42	66	204	123	151	624
Belgium	1995–1997	11	14	18	199	25	Data missing	266
Bulgaria	2002	14	9	20	98	34	Data missing	175
Croatia	2003–2005	4	1	5	92	11	19	132
Czech Republic	2003–2005	9	4	11	146	21	66	257
Denmark	1999–2001	3	4	1	78	7	15	108
Estonia	2003–2005	3	3	11	25	9	21	72
Finland	2003–2005	3	2	10	61	12	29	116
France	2002–2004	47	41	19	880	129	276	1 393
Georgia	1999–2001	0	7	2	21	9	39	79
Germany	2002–2004	54	39	25	1 000	81	221	1 419
Greece	1998–1999	19	3	34	269	21	Data missing	346
Hungary	2003–2005	5	5	9	111	25	38	193
Israel	2000–2003	6	5	3	124	14	54	206
Italy	1998–2000	54	9	10	797	55	Data missing	925
Kazakhstan	2004	63	49	150	450	349	601	1662
Kyrgyzstan	2003–2005	31	7	23	103	114	201	480
Latvia	2003–2005	4	10	6	54	30	29	133
Lithuania	2002–2004	8	7	15	99	38	36	204
Netherlands	2002–2004	7	6	4	158	27	38	241
Norway	2002–2004	4	3	5	57	9	18	96
Poland	2003–2005	49	19	50	648	157	243	1 166
Portugal	2000–2003	16	4	5	198	18	58	300
Republic of Moldova	2004–2006	10	8	25	74	62	89	269
Romania	2002–2004	63	44	121	351	230	313	1 122
Russian Federation	2003–2005	606	586	1 181	4 505	2 030	4 128	13 037
Slovakia	2003–2005	9	2	3	83	24	35	157
Slovenia	2003–2005	2	1	1	29	2	8	43
Spain	2002–2004	37	14	16	602	64	125	857
Sweden	2002–2004	2	2	6	73	10	65	158
Switzerland	2002–2004	10	1	2	73	9	26	121
The former Yugoslav Republic of Macedonia	1998–2000	2	1	2	19	9	Data missing	34
Ukraine	2005	122	87	212	1 004	580	907	2 912
United Kingdom	2002–2004	30	45	44	587	45	357	1 107
Uzbekistan	2004–2005	153	75	54	442	664	734	2 121
Total		**1 530**	**1 258**	**2 202**	**13 910**	**5 156**	**9 085**	**33 140**

Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.
Countries in the WHO European Region with a population of less than 1 million inhabitants were excluded: Andorra, Cyprus, Iceland, Luxembourg, Malta, Monaco, Montenegro and San Marino.

Table 5

Average annual lives saved by preventing each type of unintentional injury among children and adolescents aged 0–19 years if all countries had the same mortality rate as the country with the lowest mortality rate in the WHO European Region, 2003–2005 or the latest three years

Country	Years studied	Lives saved by injury cause						
		Falls	Fire	Poisoning	RTIs	Drowning	Other unintentional injury	Total
Albania	1999–2001	8	2	9	0	38	Data missing	57
Austria	2003–2005	12	2	1	57	6	11	88
Azerbaijan	2001–2002	4	95	16	0	43	84	242
Belarus	2002–2003	38	40	63	122	115	126	505
Belgium	1995–1997	10	13	16	120	17	Data missing	174
Bulgaria	2002	13	8	19	41	29	Data missing	109
Croatia	2003–2005	4	0	4	59	8	9	84
Czech Republic	2003–2005	8	3	9	75	14	44	152
Denmark	1999–2001	2	3	0	37	3	3	47
Estonia	2003–2005	3	3	11	15	8	18	57
Finland	2003–2005	2	2	9	21	8	17	58
France	2002–2004	36	34	6	390	82	128	677
Georgia	1999–2001	0	7	1	0	5	27	40
Germany	2002–2004	41	32	10	448	27	54	612
Greece	1998–1999	17	2	32	189	13	Data missing	253
Hungary	2003–2005	4	4	7	38	18	16	87
Israel	2000–2003	5	4	1	46	6	30	92
Italy	1998–2000	46	4	1	429	19	Data missing	498
Kazakhstan	2004	59	47	146	278	332	549	1 410
Kyrgyzstan	2003–2005	30	6	22	32	107	179	376
Latvia	2003–2005	4	10	5	37	28	23	108
Lithuania	2002–2004	7	7	14	70	36	28	161
Netherlands	2002–2004	5	4	1	29	15	0	53
Norway	2002–2004	3	3	4	19	5	7	40
Poland	2003–2005	42	15	42	339	127	149	713
Portugal	2000–2003	15	3	3	123	11	35	191
Republic of Moldova	2004–2006	10	8	25	51	60	82	236
Romania	2002–2004	59	41	117	178	214	261	869
Russian Federation	2003–2005	581	571	1 152	3 384	1 921	3 788	11 397
Slovakia	2003–2005	8	2	2	40	20	22	93
Slovenia	2003–2005	2	1	1	20	1	5	29
Spain	2002–2004	31	10	9	326	37	41	454
Sweden	2002–2004	0	1	4	0	4	44	53
Switzerland	2002–2004	9	0	1	19	4	10	43
The former Yugoslav Republic of Macedonia	1998–2000	2	1	2	0	7	Data missing	12
Ukraine	2005	114	82	203	662	547	803	2 412
United Kingdom	2002–2004	19	39	31	107	0	212	407
Uzbekistan	2004–2005	144	70	43	58	627	618	1 559
Total		**1 393**	**1 175**	**2 040**	**7 857**	**4 561**	**7 421**	**24 447**

Source: WHO European Health for All mortality database. Copenhagen, WHO Regional Office for Europe.
Shaded areas indicate the countries with the lowest rate per injury type used to derive estimated death rates.

Table 6

Hospital discharge rates per 100 000 population among children and adolescents aged 0–19 years by age group and sex, selected European countries, 2004

Country	All	Males	Females	Males				Females			
		1–19 years	1–19 years	1–4 years	5–9 years	10–14 years	15–19 years	1–4 years	5–9 years	10–14 years	15–19 years
Austria	2993	3411	2599	2455	2093	2777	5130	2006	1443	1652	2222
Bulgaria	592	737	456	815	793	1031	877	626	499	463	397
Czech Republic	1265	1015	1527	1397	1389	1667	1974	1210	942	956	936
Denmark	1216	1289	1145	892	954	1190	1752	707	650	715	794
Estonia	1212	1652	837	1367	995	1506	1289	1052	763	680	498
Finland	2021	2256	1796	853	920	1376	2255	623	604	776	859
Germany	1880	1930	1820	1890	1630	1870	2720	1580	1170	1200	1360
Hungary	1270	1617	956	1488	1455	1719	1641	1238	942	924	768
Italy	1469	1057	1611	996	965	1464	2498	774	590	582	823
Netherlands	672	690	653	641	576	670	960	502	474	432	504
Norway	1599	1682	1517	1059	1105	1336	2260	704	733	861	1225
Portugal	608	712	510	608	552	571	793	450	322	279	261
Slovenia	1431	1798	1080	1301	1172	1440	2180	897	751	690	912
Spain	539	593	487	563	502	579	778	411	283	239	232
Switzerland	1358	1340	1375	1032	1026	1320	1561	788	703	833	847

Source: APOLLO Hospital Discharge Database [online database]. Navarre, University of Navarre, 2008 (https://www.unav.es/ecip/apollo/asistente).

Table 7

Estimated absolute numbers of deaths among children and adolescents aged 0–19 years by sex, age group and country income per capita in the WHO European Region, 2004

Sex	Income level	<1 year	1–4 years	5–9 years	10–14 years	15–19 years	0–19 years
ALL UNINTENTIONAL INJURIES							
Boys	All	2 305	5 143	3 586	4 077	13 849	28 960
	HIC	150	488	409	591	3 550	5 188
	LMIC	2 155	4 656	3 177	3 486	10 299	23 773
Girls	All	2 048	3 032	1 863	1 861	4 358	13 163
	HIC	135	345	250	302	1 017	2 049
	LMIC	1 914	2 686	1 614	1 559	3 341	11 114
Both sexes	All	4 353	8 175	5 450	5 938	18 207	42 123
	HIC	284	833	659	893	4 567	7 236
	LMIC	4 069	7 342	4 791	5 045	13 641	34 887
ROAD TRAFFIC INJURIES							
Boys	All	303	754	1 208	1 450	7 567	11 282
	HIC	31	112	182	337	2 778	3 440
	LMIC	272	642	1 027	1 113	4 789	7 842
Girls	All	137	541	777	750	2 621	4 827
	HIC	21	113	134	182	810	1 260
	LMIC	116	428	643	569	1 811	3 567
Both sexes	All	440	1 295	1 985	2 200	10 188	16 109
	HIC	52	225	316	519	3 588	4 700
	LMIC	388	1 070	1 669	1 681	6 600	11 409
DROWNING							
Boys	All	55	1 589	937	807	856	4 244
	HIC	10	131	66	37	142	387
	LMIC	44	1 457	871	770	714	3 856
Girls	All	78	746	314	373	195	1 707
	HIC	11	58	20	16	24	128
	LMIC	68	688	294	358	171	1 579
Both sexes	All	133	2 334	1 251	1 181	1 051	5 950
	HIC	21	189	86	53	166	515
	LMIC	112	2 145	1 165	1 128	885	5 435
FIRE-RELATED BURNS							
Boys	All	89	521	135	109	136	989
	HIC	5	31	15	19	24	94
	LMIC	84	490	120	89	112	895
Girls	All	111	359	100	85	86	741
	HIC	6	38	14	17	15	90
	LMIC	105	321	87	68	71	651
Both sexes	All	200	879	235	193	222	1 730
	HIC	11	68	29	36	39	184
	LMIC	190	811	206	157	183	1 546

FALLS							
Boys	All	102	305	151	233	359	1 150
	HIC	9	56	21	33	100	218
	LMIC	93	249	130	201	260	932
Girls	All	92	161	73	74	97	497
	HIC	6	21	13	15	19	76
	LMIC	86	140	60	58	78	422
Both sexes	All	194	466	224	307	457	1 647
	HIC	15	78	34	48	119	294
	LMIC	179	388	190	259	338	1 354

POISONING							
Boys	All	174	474	149	157	871	1 825
	HIC	2	8	8	9	107	134
	LMIC	172	467	141	148	764	1 691
Girls	All	165	323	112	142	432	1 174
	HIC	0	6	3	11	48	68
	LMIC	165	317	110	131	384	1 106
Both sexes	All	339	797	261	299	1 303	2 999
	HIC	2	14	10	20	155	201
	LMIC	337	783	251	279	1 148	2 797

OTHER UNINTENTIONAL INJURIES							
Boys	All	1 583	1 501	1 006	1 321	4 060	9 471
	HIC	93	149	117	156	398	914
	LMIC	1 489	1 351	889	1 165	3 661	8 557
Girls	All	1 465	902	486	437	927	4 217
	HIC	91	110	65	61	101	428
	LMIC	1 374	793	421	375	826	3 789
Both sexes	All	3 047	2 403	1 493	1 758	4 987	13 688
	HIC	184	259	183	217	499	1 342
	LMIC	2 863	2 144	1 310	1 541	4 487	12 345

HIC: high-income countries; LMIC: low- and medium income countries.
Source: The global burden of disease: 2004 update. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

Table 8

Estimated mortality rate per 100 000 population among children and adolescents aged 0–19 years by sex, age group and country income per capita in the WHO European Region, 2004

Sex	Country income group	<1 year	1–4 years	5–9 years	10–14 years	15–19 years	0–19 years
ALL UNINTENTIONAL INJURIES							
Boys	All	42.7	24.8	13.4	13.4	41.1	24.8
	HIC	6.7	5.5	3.6	5.0	28.5	11.1
	LMIC	68.6	39.3	20.4	18.9	48.5	33.9
Girls	All	40.1	15.4	7.3	6.4	13.5	11.8
	HIC	6.3	4.1	2.3	2.7	8.6	4.6
	LMIC	64.2	23.9	10.9	8.8	16.3	16.5
Both sexes	All	41.4	20.2	10.4	10.0	27.6	18.4
	HIC	6.5	4.8	3.0	3.9	18.8	7.9
	LMIC	66.4	31.8	15.8	14.0	32.7	25.4
ROAD TRAFFIC INJURIES							
Boys	All	5.6	3.6	4.5	4.8	22.5	9.6
	HIC	1.4	1.3	1.6	2.8	22.3	7.4
	LMIC	8.7	5.4	6.6	6.0	22.6	11.2
Girls	All	2.7	2.8	3.0	2.6	8.1	4.3
	HIC	1.0	1.3	1.3	1.6	6.8	2.8
	LMIC	3.9	3.8	4.3	3.2	8.9	5.3
Both sexes	All	4.2	3.2	3.8	3.7	15.4	7.0
	HIC	1.2	1.3	1.4	2.2	14.8	5.2
	LMIC	6.3	4.6	5.5	4.7	15.8	8.3
DROWNING							
Boys	All	1.0	7.7	3.5	2.7	2.5	3.6
	HIC	0.5	1.5	0.6	0.3	1.1	0.8
	LMIC	1.4	12.3	5.6	4.2	3.4	5.5
Girls	All	1.5	3.8	1.2	1.3	0.6	1.5
	HIC	0.5	0.7	0.2	0.1	0.2	0.3
	LMIC	2.3	6.1	2.0	2.0	0.8	2.4
Both sexes	All	1.3	5.8	2.4	2.0	1.6	2.6
	HIC	0.5	1.1	0.4	0.2	0.7	0.6
	LMIC	1.8	9.3	3.8	3.1	2.1	4.0
FIRE-RELATED BURNS							
Boys	All	1.7	2.5	0.5	0.4	0.4	0.9
	HIC	0.2	0.3	0.1	0.2	0.2	0.2
	LMIC	2.7	4.1	0.8	0.5	0.5	1.3
Girls	All	2.2	1.8	0.4	0.3	0.3	0.7
	HIC	0.3	0.5	0.1	0.2	0.1	0.2
	LMIC	3.5	2.9	0.6	0.4	0.4	1.0
Both sexes	All	1.9	2.2	0.5	0.3	0.3	0.8
	HIC	0.3	0.4	0.1	0.2	0.2	0.2
	LMIC	3.1	3.5	0.7	0.4	0.4	1.1

FALLS							
Boys	All	1.9	1.5	0.6	0.8	1.1	1.0
	HIC	0.4	0.6	0.2	0.3	0.8	0.5
	LMIC	3.0	2.1	0.8	1.1	1.2	1.3
Girls	All	1.8	0.8	0.3	0.3	0.3	0.5
	HIC	0.3	0.3	0.1	0.1	0.2	0.2
	LMIC	2.9	1.2	0.4	0.3	0.4	0.6
Both sexes	All	1.9	1.2	0.4	0.5	0.7	0.7
	HIC	0.3	0.5	0.2	0.2	0.5	0.3
	LMIC	2.9	1.7	0.6	0.7	0.8	1.0

POISONING							
Boys	All	3.2	2.3	0.6	0.5	2.6	1.6
	HIC	0.1	0.1	0.1	0.1	0.9	0.3
	LMIC	5.5	3.9	0.9	0.8	3.6	2.4
Girls	All	3.2	1.6	0.4	0.5	1.3	1.1
	HIC	0.0	0.1	0.0	0.1	0.4	0.2
	LMIC	5.5	2.8	0.7	0.7	1.9	1.7
Both sexes	All	3.2	2.0	0.5	0.5	2.0	1.3
	HIC	0.0	0.1	0.1	0.1	0.6	0.2
	LMIC	5.5	3.4	0.8	0.8	2.8	2.0

OTHER UNINTENTIONAL INJURIES							
Boys	All	29.4	7.2	3.8	4.4	12.1	8.1
	HIC	4.1	1.7	1.0	1.3	3.2	2.0
	LMIC	47.4	11.4	5.7	6.3	17.3	12.2
Girls	All	28.7	4.6	1.9	1.5	2.9	3.8
	HIC	4.3	1.3	0.6	0.5	0.9	1.0
	LMIC	46.1	7.1	2.8	2.1	4.0	5.6
Both sexes	All	29.0	6.0	2.9	3.0	7.6	6.0
	HIC	4.2	1.5	0.	0.9	2.1	1.5
	LMIC	46.8	9.3	4.3	4.3	10.8	9.0

HIC: high-income countries; LMIC: low- and medium income countries.
Source: *The global burden of disease: 2004 update*. Geneva, World Health Organization, 2008 (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, accessed 21 November 2008).

World Health Organization
Regional Office for Europe
Scherfigsvej 8
DK–2100 Copenhagen Ø
Denmark
Tel.: +45 39 17 17 17
Fax: +45 39 17 18 18
E-mail: postmaster@euro.who.int

www.euro.who.int/violenceinjury