

Environmental Health in Israel 2014

הקרן לבריאות וסביבה
Environment and Health Fund

Public Health Services
MINISTRY OF HEALTH
For a healthier life

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About the Environment and Health Fund

The Environment and Health Fund (EHF) is committed to expanding expertise in and knowledge about environmental health in Israel. EHF builds capacity and capabilities by supporting inter-disciplinary research, in-service professional training, and workshops and conferences. EHF helps connect Israeli scientists and policy makers to a network of international experts in environmental health research and policy.
EHF works with scientists and professionals, government and the private sector to broaden stakeholder involvement in reducing exposure to environmental hazards and improving public health.

Environmental Health in Israel 2014

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Preface

This report, Environmental Health in Israel 2014, is the result of an extremely productive partnership between an NGO, the Environment and Health Fund and a government agency, the Public Health Services at the Ministry of Health. It is made possible by the commitment of both to improving the health of Israelis by reducing their exposures to environmental hazards. What that means in practice is taking a good hard look at what we know – what we count, what we measure, what we monitor, both with respect to environmental hazards, and to health endpoints. And at the same time, it means asking what more needs to be done in order to improve environmental health policy.

Prof. Itamar Grotto, Director of the Public Health Services at the Ministry continues to play a leadership role in environmental health research and policy. Dr. Tamar Berman, Chief Toxicologist of Environmental Health, who spearheaded the effort, with the help of Dr. Isabella Karakis and Dr. Shay Reicher, worked for months writing the report and integrating the comments and corrections of two dozen reviewers with specific content area expertise. The full list of reviewers who contributed to the report can be found on page 93.

The report presents a snapshot of the current situation in Israel with regard to data and monitoring, ongoing research, current regulation, along with a description of recent progress and the challenges for the near future. There will no doubt be aspects we have missed. There will be those who find this report too critical, while others will surely say it is not critical enough. We have attempted to candidly present the challenges, in the context of bringing stakeholders together to work towards a common goal. We welcome readers' comments and corrections.

This first edition of Environmental Health in Israel is intended to provide a baseline against which we can measure the extent to which we have moved towards our goal when we reassess our progress several years down the line. Although there has been progress in the field of environmental health over the past seven years, there remains much room for improvement.

Read Dr. Linda Birnbaum's concluding chapter to get a sense of what that agenda should look like. Our hope is that Environmental Health in Israel 2014 will help lay out the priorities for work in this field for the next five to seven years.

I would like to thank the Board and the Staff of the Environment and Health Fund for their commitment to this project. Thanks are due to Na'ama Shilony, Logistics Coordinator at EHF, for her investment of time and effort in the production of this report.

Ruth Ostrin, PhD
Director
Environment and Health Fund

Introduction

Human health and environmental health are closely interrelated. The recognition that the environment has a significant impact on human health led to improvements in sanitary conditions in both residential and medical environments. Indeed, this improvement in environmental conditions was beneficial to public health and led to both an increase in life expectancy and a decrease in infant mortality.

In the modern era there have been fundamental changes in the nature of environmental risk factors. We are witnessing an accumulation of new, exciting scientific evidence regarding these risks. Despite the positive developments in environmental health in recent years, there is still much work ahead of us.

The effects of environmental factors on human health are complex and difficult to assess, since they depend on many factors and a range of variables. Furthermore, there are still knowledge gaps in understanding the way environmental exposures can influence the health of the general population, especially in vulnerable sub-populations. Addressing environmental health issues is uniquely complex because of the many agencies and organizations involved in environmental issues affecting health. Therefore, it is difficult at times to get a complete and up-to-date view of the state of environmental health issues.

This report is unique in that it summarizes, for the first time, a wide range of environmental health topics in Israel. The aim of this report is to present information accumulated over the past five years (2010-2014), and to summarize the major environmental health issues currently on the agenda of decision makers in the field.

This document can serve as a tool for stakeholders in the field, and can serve as a point of reference for tracking changes which will occur in this field in the future.

This report includes twelve chapters, and each chapter addresses a number of issues: the effects of the relevant environmental issue on human health, current regulation and policy in Israel, relevant health data gathered in Israel in recent years, up-to-date scientific research conducted in Israel, as well as a section dedicated to summarizing the progress that has been made in this field as well as the challenges facing us.

This report is the product of a joint initiative by the Public Health Services and the Environment and Health Fund. Representatives from government, institutions, non-governmental agencies, and academia contributed to the joint effort of preparing this report. This document would not have been completed were it not for the ongoing dialogue and collaboration on environmental health issues among the many organizations whose common goal is to protect public health. I would like to thank all the experts who contributed to this report, and especially Dr. Linda Birnbaum, Director of the US National Institute of Environmental Health Sciences, for her unique contribution.

Prof. Itamar Grotto, MD, MPH, PhD
Director of Public Health Services
Israel Ministry of Health

Chapter 1

Ambient Air Quality

Exposure to ambient air pollution – even at very low concentrations – is associated with a range of adverse health effects in the general population, including asthma and other respiratory diseases, cardiovascular morbidity and mortality, cancer, neurodevelopmental effects, and adverse birth outcomes. In 2013, the International Agency for Research on Cancer (IARC) classified outdoor air pollution as carcinogenic to humans (Group 1). Scientific evidence indicates that the major air pollutants associated with adverse health effects are particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Additional ambient air pollutants including benzene, formaldehyde and selected polycyclic aromatic compounds are known human carcinogens.

Standards and Policy

Ambient air quality is regulated according to the Israel Clean Air Law, which was approved in 2008 and entered into force in January 2011. Prior to the Clean Air Law, ambient air quality in Israel was regulated according to more than ten different laws and standards, including the 1992 Prevention of Nuisance Standards which set maximum ambient air pollutant levels. These levels were generally less stringent than those recommended by the World Health Organization (WHO) or the European Union limit values.

The main prohibitions and obligations according to the Clean Air Law are:

- Air quality values will be set by the Ministry of Environmental Protection (MoEP) and updated regularly. Air Quality values include (a) target values whose exceedance constitutes potential

harm to public health; (b) environmental values which are based on target values but take into account practical achievability; and (c) alarm values whose exceedance, even for short periods, causes or is likely to cause danger or harm to human health.

- The MoEP is required to inform the general public about high air pollution levels and provide recommendations for sensitive populations including pregnant women, children, the elderly, and individuals with heart or lung disease.
- Industrial plants with a potential for high air pollution emissions are required to obtain emissions permits, based on the best available technologies for reducing emissions, as a prerequisite for continued activity.
- The MoEP is required to prepare a National Pollution Reduction and Prevention Program, which will enable compliance with the Israel ambient air quality standards and will aspire to comply with the target values.
- The MoEP will enforce penalties against violators of the Israel Clean Air Law who endanger human health.

Regulations establishing air quality standards entered into force in May 2011 and updated regulations will enter into force in January 2015. The regulations include environmental values (ambient air quality standards) for 28 contaminants, including PM, gases (criteria pollutants), volatile organic compounds (VOCs), and heavy metals. Below is a comparison of the ambient air quality standards for selected criteria air pollutants, in the current and 2015 standards:

Current and Future Ambient Air Quality Standards (criteria pollutants) in Israel (μg/m^3)

→ Table 1

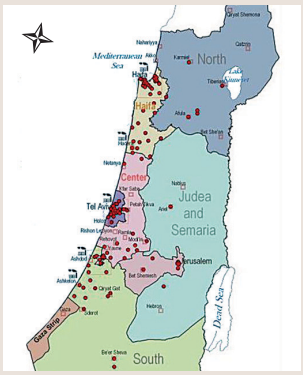
	Time Interval	Current	2015	World Health Organization Guideline Values
PM_{10}	**24 h**	150	130 – with up to 18 annual exceedances	50
	Annual	60	50	20
$PM_{2.5}$	**24 h**	-	37.5 - with up to 18 exceedances	25
	Annual	-	25	10
Ozone	**30 min**	230 (half hour)	-	-
	8 h	160	140 - with up to 10 annual exceedances	100
Nitrogen Dioxide	**1 h**	200	200 - with up to 8 annual exceedances	200
	Annual	-	40	40
Sulfur Dioxide	**10 min**	-	-	500
	1 h	350	350 - with up to 8 annual exceedances	-
	Daily	125	50 - up to 4 annual exceedances	20
	Annual	60	20	-

Israel air quality standards are high compared to European standards for PM_{10} and ozone, and to US standards for ozone and $PM_{2.5}$.

As mandated by the Clean Air Law, the MoEP developed a multi–year (2012-2020) National Pollution Reduction and Prevention Program. Ambient air pollution measures required by the program include measures related to the following sectors: energy, industry, transportation, and household. A version of the program was approved in August 2013 after extended negotiations regarding the program's budget.

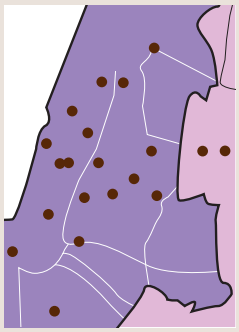
Data on Ambient Air Pollution in Israel

Ambient Air Monitoring Stations in Israel

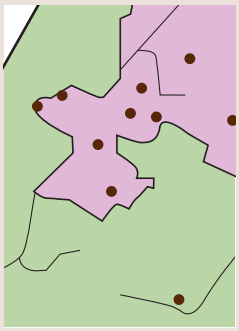




Haifa Area



Tel Aviv Area



Ashdod Area

← **Figure 1**
Source: Israeli Ministry of Environmental Protection

The National Air Monitoring System in Israel includes over 140 monitoring stations which are managed by a range of different bodies: municipal environmental assocations, the Israel Electric Company, industry, port authorities, bus stations, and the MoEP. Air monitoring data are available on the National Air Monitoring Network website.

The MoEP distinguishes between two types of monitoring stations: traffic monitoring stations and general monitoring stations. Traffic stations measure primary pollutants emitted from vehicles, such as nitrogen oxides/nitrogen dioxide (NO_x/NO_2), carbon monoxide (CO), $PM_{2.5}$, and VOCs (such as benzene, toluene, ethylbenzene, xylene, and 1, 3-Butadiene). General stations measure airborne pollutants such as sulfur dioxide, nitrogen oxides/nitrogen dioxide, ozone, carbon monoxide and PM.

Sources and Composition of Particulate Matter in Israel

Israel has high background levels of PM, from local natural dust and long range transport of PM from neighboring countries. On average, over 50% of $PM_{2.5}$ levels in Israel are due to long range transport, mostly from Europe and the Mediterranean basin. During the winter and in transition seasons, levels are especially high due to long range transport from the Sahara and Arabian

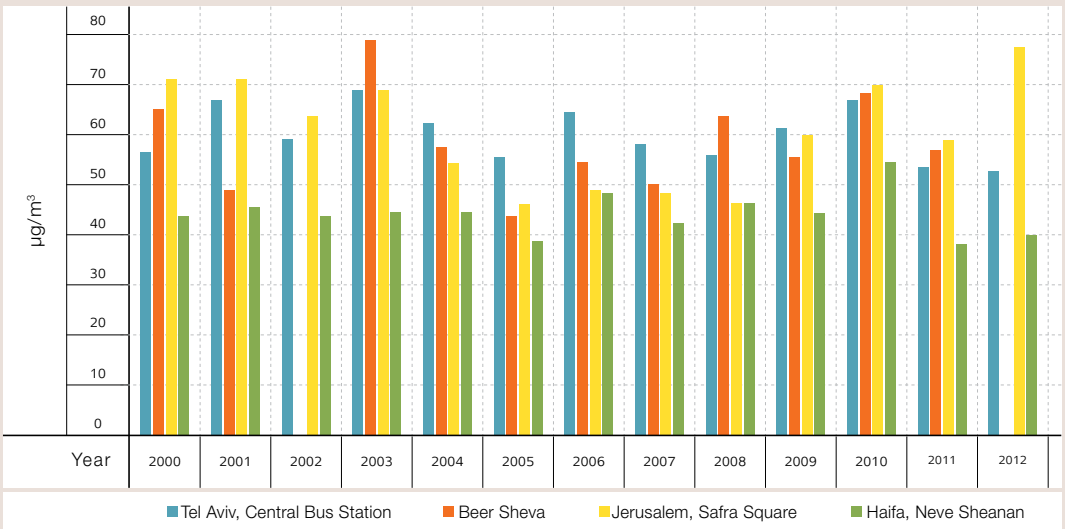
Deserts. Anthropogenic contaminants that may adsorb onto dust particles during their transport exacerbate adverse health effects resulting from exposure to these particles. Local sources of particulates in Israel include combustion processes in power plants, industry, transportation, and home heating, in addition to photochemical oxidation of sulfur dioxide, nitrogen oxides, and VOCs. Within major metropolitan cities in Israel, anthropogenic sources of PM are primarily transportation sources, including diesel engines. Research has shown that circulation patterns affect PM composition in Israel more than local emissions.

Ambient Air Quality in Israel

According to the WHO ambient air pollution database update from 2014, Israel is ranked as the 24th highest out of 90 countries for annual mean PM_{10} and 44th highest for annual mean $PM_{2.5}$. Within Israel, the highest annual PM_{10} levels were in Ashkelon, followed by Modi'in, while the highest $PM_{2.5}$ levels were in Modi'in, followed by Beer Sheva and Beit Shemesh. However, this analysis has several limitations. First, the comparison was based on data from 2010, during which there were many dust storms in Israel, and on data from monitoring stations that are positioned in Israel relatively close to emissions sources. In addition, the comparison considered only PM and not additional ambient pollutants with considerable public health impact.

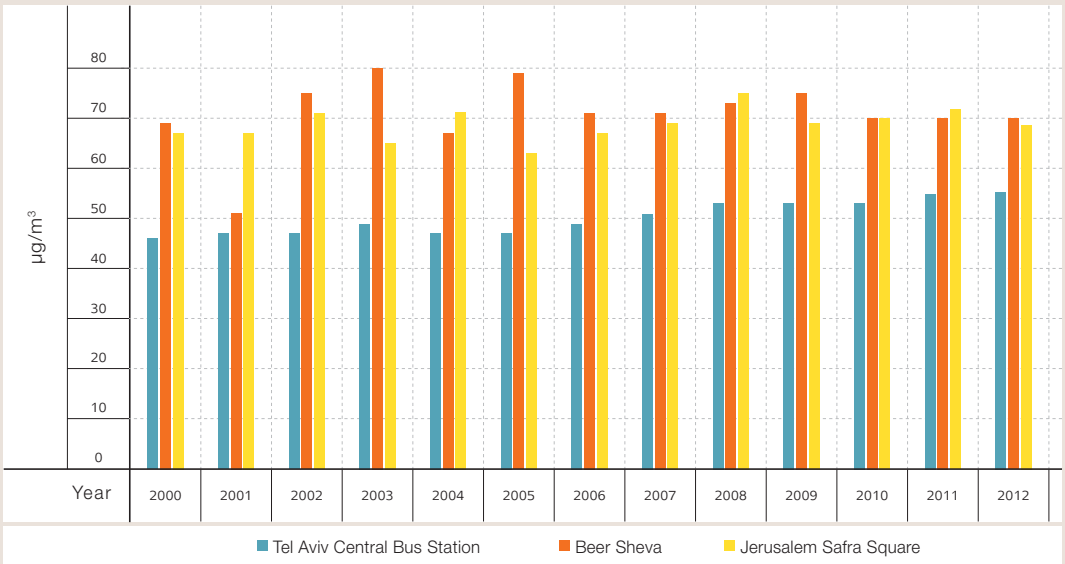
While PM emissions have decreased by about 30% since 2000, annual ambient PM_{10} concentrations remained stable (Figure 2). $PM_{2.5}$ concentrations, which range between 17–29 $\mu g/m^3$ vary considerably according to region in Israel. For ozone, annual average concentrations remained stable during 2000–2012 at most monitoring stations (Figure 3). In many areas in Israel, the eight-hour average ozone concentrations exceed WHO recommendations, including in large urban areas such as Tel Aviv, Jerusalem, and Beer Sheva, primarily due to heavy transport pressures.

Annual PM_{10} Concentrations at Selected Monitoring Stations in Israel, 2000–2012



→
Figure 2
Source: Israeli Ministry of Environmental Protection

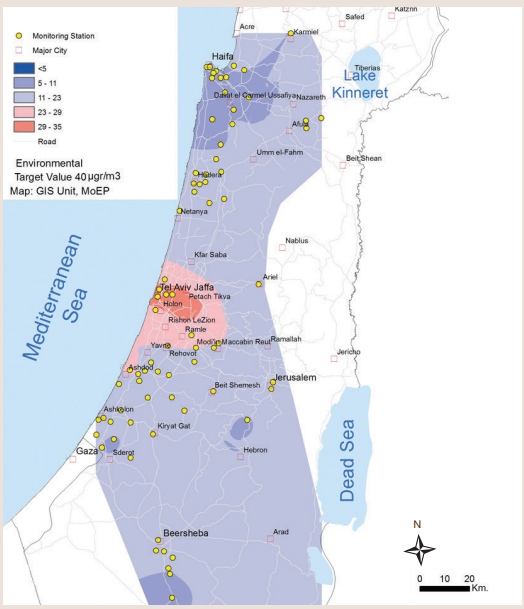
Annual Ozone Concentrations at Selected Monitoring Stations in Israel, 2000-2012



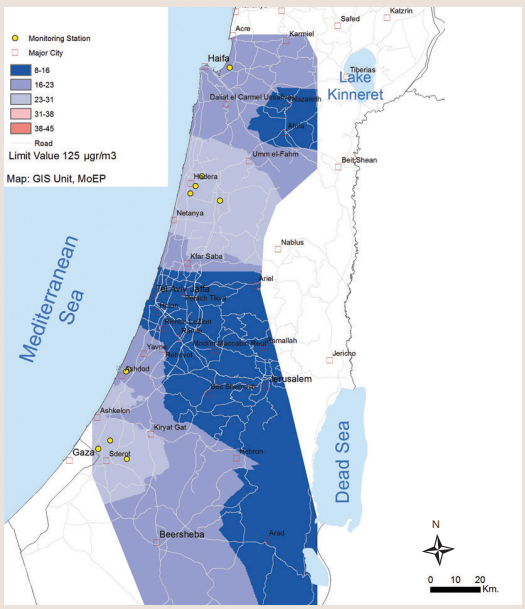
← **Figure 3**
Source: Israeli Ministry of Environmental Protection

According to the Organisation for Economic Co-operation and Development (OECD) Environmental Performance Review for Israel from 2011, sulfur dioxide and nitrogen dioxide emissions have steadily decreased due to improvements in fuel quality and improved vehicle technology. On the other hand, emissions of a few types of VOCs have continued to increase. There has been a steady decrease in ambient levels of nitric oxide between 2001 and 2012, a slight decrease in ambient nitrogen dioxide levels, and a slight decrease in ambient sulfur dioxide levels. Figures 4 and 5 show the geographic variability of these pollutants in 2012.

Annual Mean Concentrations of NO_2, 2012



SO_2 Daily Concentrations, 2012



← **Figure 4+5**
Source: Israeli Ministry of Environmental Protection

Data on Health Effects Associated with Air Pollution in Israel

National data are available for health outcomes associated with ambient air pollution, including asthma, cardiovascular disease, stroke and cancer in the adult population. However, as these data have not been linked to data on air pollution, it is difficult to ascertain the air pollution-related incidence of these diseases on a national level. National data on health outcomes in children in Israel are limited. For example, the most recent national data on asthma prevalence in children are from 2008.

As part of a cost-benefit analysis conducted within the framework of the National Pollution Reduction and Prevention Program, adverse health effects associated with exceeding target levels of selected air pollutants were calculated for 2015 and 2020 based on modeled air concentrations. Adverse health effects associated with current monitored ambient air pollution have not been calculated on a national level.

Predicted Health Effects Associated with Ambient Air Pollution above the Target Value, 2015 and 2020

→ Table 2

	2015	2020
$PM_{2.5}$ loss of life, chronic exposure	27,860 life years	30,310 life years
$PM_{2.5}$ lung cancer	166.8	156.6
$PM_{2.5}$ ischemic heart disease mortality	448.11	422.42
PM_{10} premature death, acute exposure	149.2	135.3
PM_{10} cardiovascular hospitalizations	53.9	47.9
PM_{10} respiratory hospitalizations	396.5	359.5
PM_{10} asthma, medicine use days	2,229.7	2,021.6
Ozone, premature death, acute exposure	20.8	26.7
Ozone, respiratory hospitalizations	44	56

The cost associated with exceeding the target values for PM and ozone was estimated at NIS 22 billion in 2015 and NIS 24 billion in 2020.

Research on Ambient Air Pollution in Israel: Exposure Assessment and Health Effects

Between 2010 and 2014 Israeli research groups published more than 25 articles on air pollution and health outcomes, including studies on childhood asthma, risk of ischemic stroke, post-myocardial infarction mortality, respiratory effects, congenital heart defects, cancer incidence, and reduced functional capacity.

Many studies have focused on populations in northern Israel, including those in Hadera and Haifa. In addition, Israeli researchers published articles on remote sensing and air pollution, evaluating multi-pollutant exposure in urban settings, and a new bacterial bioassay for toxicity of particulate air pollution.

Ongoing studies

- Researchers from the Technion Center of Excellence in Exposure Science and Environmental Health (TCEEH) are studying exposure to ambient air pollution in heterogeneous urban areas and exposure to pesticide drift at agricultural-residential interfaces. TCEEH researchers are building a ready-to-use air pollution database, available to the research community.
- Researchers from Tel Aviv University and the Technion are studying relationships between exposure to air pollutants and traffic-related ambient pollutants in particular and recurrent cardiovascular events, ischemic heart disease, stroke, and frailty.
- Researchers from the Technion Faculty of Biomedical Engineering are developing cytotoxicity assays of inhaled toxic ultrafine particles on alveolar epithelial cells.
- Researchers from the University of Haifa and the Ministry of Health are studying the impact of air pollution on birth outcomes including low birth weight.
- Researchers at the Gertner Institute for Epidemiology and Health Policy, Weizmann Institute of Science, and Tel Aviv University are studying the impact of air pollution on reproductive outcomes following in vitro fertilization and spontaneous pregnancies.
- Researchers from Ben-Gurion University are studying the relationship between emissions from industrial sources and child health, including mental and motor development in the first years of life.
- Researchers from Ben-Gurion University are studying the impact of chronic and acute exposure to soil-derived airborne particles on pulmonary and ischemic heart disease in the northern Negev.
- Researchers from the Hebrew University of Jerusalem are studying the association between exposure to traffic-related air pollution in adolescence and health status at age 17, as well as with cancer incidence and cause-specific mortality in adulthood.
- Researchers from the Hebrew University of Jerusalem are using telemedicine to assess associations between acute cardiovascular events and ambient PM air pollution in the Tel Aviv and Haifa metropolitan areas.

Progress and Challenges

- The Clean Air Law, which came into force in 2011, marks major progress in establishing a comprehensive regulatory framework for improving ambient air quality in Israel. The Clean Air Regulations passed in 2011 and the regulations which will enter into force in 2015 are expected to lead to reductions in concentrations of ambient contaminants in Israel and to a reduction in air pollution-related morbidity and mortality. However, for many ambient air pollutants with major public health effects, ambient air quality standards are significantly higher than the target values. Both the target values and the air quality standards need to be re-evaluated periodically (within five years) to ensure that the Clean Air Regulations are indeed protective of public health.
- Ambient concentrations of PM_{10}, ozone and nitrogen oxides continue to exceed maximum limit values in major metropolitan areas. Adoption of the National Pollution Reduction and Prevention Program is expected to lead to reductions in ambient air pollution emissions of VOCs, sulfur dioxide, nitrogen oxides and benzene but not PM. Since the Treasury funded only a modified form of the National Pollution Reduction and Prevention Program, the decrease in emissions will not be as significant as intended by the original program.
- Transport demand and private car ownership are increasing steadily in Israel. Measures to reduce transport emissions have included adoption of European standards for imported vehicles, fuel quality, and vehicle tests. There are significant challenges in integrating transport and land use planning, improving alternatives to private car use, and promoting sustainable urban design.
- The National Air Monitoring Network is one of the densest in the world and data are widely available to the general public and to researchers. Lack of uniformity in data collection and quality control among different monitoring stations hinders the reliability of the data collected prior to June 2013. Since then, improvements in the MoEP guidelines and procedures for monitoring ambient air have led to improvements in data comparability from different monitoring systems. However, spatial distribution of monitoring stations is uneven and data are lacking on ambient air levels in selected geographical areas in Israel.
- To date, there is no strategy for regular sampling of air pollutants that cannot be monitored continuously, including PM-bound metals, persistent organic pollutants, polycyclic aromatic hydrocarbons, endocrine disrupting chemicals, and polybrominated diphenylethers.

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Chapter 2

Indoor Air Quality

Indoor air quality (IAQ) refers to air quality within and around buildings and structures, especially with regard to the health and comfort of building occupants. Indoor exposure to air pollutants may occur in both private and public indoor environments, including homes, offices, schools, hospitals and transport systems. IAQ is affected by toxic gases (such as carbon monoxide [CO] and nitrogen oxides [NOx]), volatile organic compounds (VOCs, such as formaldehyde, benzene, toluene, styrene), pesticides, lead, flame retardants, respirable particles and dust, smoking (second-hand and third-hand), various biological pollutants (such as mold and bacteria), and physical contaminants (radiation, electromagnetic radiation, and asbestos). The main factors affecting IAQ are ventilation, indoor sources of pollutants, and the quality of ambient air entering the building.

Poor IAQ has been associated with health effects such as asthma, chronic obstructive lung diseases, bronchitis (primarily in children), allergic reactions, and an increased risk of infectious disease. Low socio-economic status is also likely to contribute to the presence of factors that significantly affect IAQ.

Current Regulations

Standards and regulations for indoor air in Israel can be divided into three categories: those related to planning and building (requirements regarding ventilation, insulation, and building materials), those related to maximum permissible concentrations of indoor air pollutants (radon), and those related to emissions from materials used in the indoor environment (formaldehyde emissions from wood products).

The Planning and Building Regulations passed in 1970, and most recently updated in 2008, require ventilation in buildings with the aim of improving IAQ. This includes requirements regarding windows, vents, and ventilation pipes. In addition, the regulations define the minimal number of air exchanges required for ventilation of indoor spaces via artificial ventilation systems.

Regulations on thermal insulation introduced in Israel in 1985 required more insulation in newly constructed buildings. However, no requirements for improving thermal insulation were imposed on existing buildings. After implementation of the regulations, the proportion of homes with condensation-related mold decreased by 25% and those with extreme mold growth decreased by 20%.

The Planning and Building Regulations passed in 1970 and most recently updated in 2008 require that buildings be planned and built in a way that prevents accumulation of high radon levels that can harm health. In addition, the regulations set maximum permissible indoor radon levels. Israel Standard 5098 also sets limits on the concentration of natural radionuclides in building products.

Although not developed specifically for indoor air pollutants, the Ministry of Environmental Protection (MoEP) 2006 Air Quality Guideline Values do provide guideline values for 110 contaminants. The 2011 Israeli Standard 6210 Ventilation for Acceptable Indoor Air Quality, based on the 2010 US standard, defines permitted values for particular indoor contaminants (including sulfur dioxide [SO_2], nitrogen dioxide [NO_2], carbon monoxide, PM_{10}, benzene, toluene, perchloroethylene and formaldehyde). This standard is not mandatory, but is expected to become mandatory within the framework of the Ministry of Construction and Housing Building Code.

There are four Israeli standards that establish maximum permissible levels of formaldehyde emissions from wood materials. In all of these standards, the sections pertaining to the emission of formaldehyde are mandatory. Due to concerns about the extra sensitivity of infants to formaldehyde, Standard 682 – which addresses the safety of infant cribs – lowers the maximum permitted value of formaldehyde in cribs to 70% of the value defined for raw materials.

Israel Standard 5281, which is voluntary, addresses sustainable building, including energy, land, water, building materials, health, waste, and transportation. The standard addresses issues related to ventilation, use of raw materials that do not emit toxics and quality of ambient air entering the building (for example from underground parking areas).

Data on Indoor Air Quality in Israel

The MoEP conducts a National Radon Gas Survey. The survey aims to identify and map regions of relatively high levels of radon gas and to define regions of potential high risk for the presence

of radon, based on measurements of radon gas concentrations in buildings. The last survey, published in 2002 was conducted in "residential secure spaces" in a nation-wide sample and in bomb shelters along the northern border. The survey found that the level of impermeability of residential secure spaces led to high short-term measurements. However, the MoEP concluded that since individuals are not expected to spend more than six consecutive hours in these residential secure spaces under normal conditions, radon levels do not exceed the recommended action level of 200 becquerels per cubic meter.

Due to concerns about excessive air pollution adjacent to bus platforms at the Central Bus Station in Jerusalem, the MoEP has been continuously monitoring daily levels of nitrogen dioxide, nitrogen oxides, and fine respirable particles ($PM_{2.5}$). The results indicate nitrogen dioxide levels in excess of warning values and high short-term concentrations of fine respirable particles, most of which were diesel particles that are known to be carcinogenic. It is important to note that bus platforms are not within a closed building and therefore do not meet the strict definition of indoor air, nevertheless emissions from the buses may impact IAQ within the bus station.

With the exception of the Jerusalem Central Bus Station, levels of indoor air contaminants in Israel are not regularly measured. The MoEP measured values of nitrogen oxides in two educational institutions in central Israel over the course of three months (January through March 2008). The concentrations measured within the buildings were similar to those tested in the outside environment. While no exceedances were reported for daily average environmental values, the study did find about 10 exceedances of the half-hour environmental value within the buildings.

In certain areas where the soil is contaminated with chlorinated organic compounds, sporadic tests are conducted to measure concentrations of chlorinated organic compounds inside buildings. Due to concerns that penetration of hazardous ground gases is polluting the air in underground spaces in the Tel Aviv area, the local authority for environmental quality has conducted measurements of chlorinated and volatile organic hydrocarbons. The pollutants found in underground spaces include: chloroform, carbon tetrachloride, trichloroethylene, tetrachloroethylene and vinyl chloride. Based on the findings in a school in the Tel Aviv area, the MoEP required the Tel Aviv Municipality to adopt various preventive measures to reduce exposure of students to indoor pollutants and recommended continued follow-up.

Research on Indoor Air Quality in Israel

- In recent years, there have been no epidemiological studies in Israel investigating the connection between IAQ and morbidity.
- Researchers at the Technion Center of Excellence in Exposure Science and Environmental Health (TCEEH) are studying the behavior of nicotine in the indoor environment and the presence of flame retardant materials in dust inside cars.

Progress and Challenges

- Since the average person spends up to 90% of his or her time inside buildings, it is important to collect data on IAQ in Israel, with an emphasis on public buildings. The MoEP in collaboration with the Ministry of Health and the Ministry of Education is planning a pilot program in schools throughout Israel in 2015. Following collection of data on IAQ, it is important to evaluate the potential health impact of exposure to indoor air pollutants in Israel, particularly among sensitive populations such as children.
- Residential dust is an important tool for assessing human exposure to indoor contaminants. There are no available data on levels of contaminants in residential dust in Israel.
- Green Building, which has recently been promoted in Israel, provides an opportunity to boost efforts to protect IAQ in new buildings, including testing of ventilation systems. Israel Standard 5281 for Sustainable Building, passed in 2011, includes reference to ventilation and air quality in buildings with forced ventilation systems and restrictions on VOC levels in buildings. However, reducing energy consumption by thermal insulation can have potentially adverse effects on IAQ in homes due to the accumulation of pollutants from indoor sources.
- The Ministry of Construction and Housing's new Building Code, which has yet to be approved, and Israel Standard 6210 (Ventilation for Acceptable Indoor Air Quality) will be able to provide guidelines for reducing human exposure to chemical, physical, and biological pollutants in indoor environments. However, it is important to emphasize that Standard 6210 does not apply to private homes, above-ground buildings of three stories or less, vehicles, or boats.
- Sick Building Syndrome, typically affecting workplaces, is an important public health issue. The Ministry of Economy and the MoEP are not authorized to routinely monitor air quality in closed buildings used as workplaces, and there is unclear division of authority between these bodies in the case of complaints regarding Sick Building Syndrome. Collaboration among the Ministries of Health, Environmental Protection, Education, and Economy is required to develop a comprehensive approach to this problem.

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Chapter 3

Environmental Tobacco Smoke

The adverse effects of environmental tobacco smoke (ETS) mirror those associated with active smoking. For example, in adults ETS increases the risk of lung cancer and heart disease. In young children, exposure to ETS increases the risk of sudden infant death syndrome, asthma, bronchitis, and pneumonia.

Current Regulations

In Israel today, smoking is prohibited in most closed public places, including hospitals, trains, public pools, restaurants, bars and pubs, places of worship, and all government buildings. However, under the current law, bars and pubs are allowed to set aside a quarter of their space for smokers, as long as it is in a separate room, and smoking is permitted in private offices and in most open spaces. The Ministry of Health (MoH) is currently developing legislation that would extend the ban on smoking in public places to electronic cigarettes and nargilehs, allow the MoH to authorize inspectors to enforce the law, and extend the current prohibition on smoking in public places to include stadiums, public parks, and other open spaces.

Exposure to Environmental Tobacco Smoke in Israel

Despite extensive legislation to prevent exposure of the non-smoking population to ETS, data show that most of the Israeli population is indeed exposed to ETS. According to the 2010 Israel

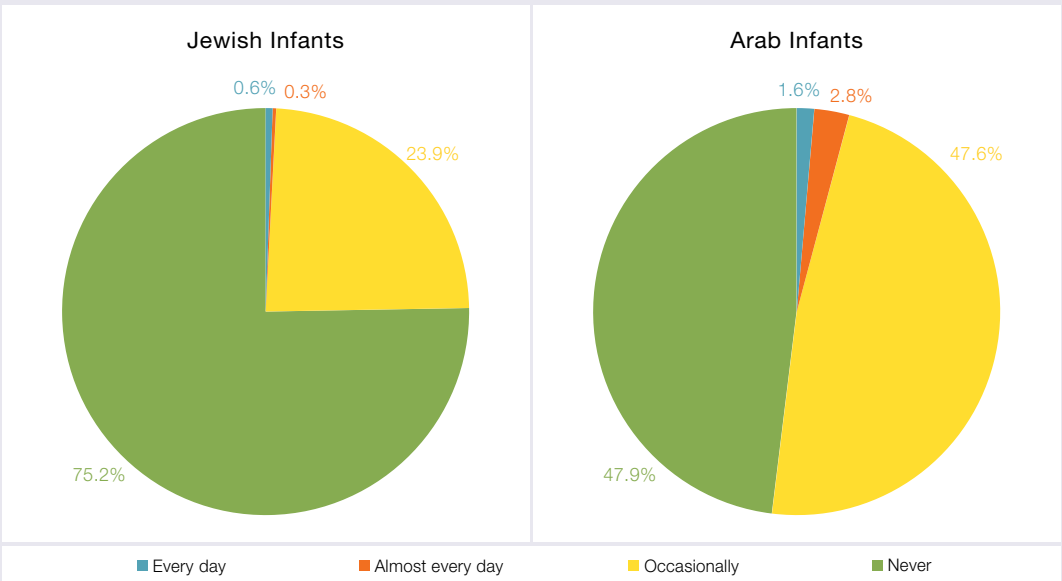
Central Bureau of Statistics Social Survey, 71.3% of non-smokers aged 20-74 reported that they had been exposed to ETS during the last month, with 17.9% reporting a high level of exposure. In a representative survey of Israeli adults (N=505) in 2010, 80.2% reported exposure to ETS, and 33.9% reported daily exposure. In a national survey in 2008 of over 11,000 adolescents, 20.5 % reported that only their father smoked at home, 5.3% reported that only their mother smoked at home, and 6.2% reported that one or more of their siblings smoked at home. Overall, 13.8% reported that more than one family member smoked, including both parents (11.3%), and 3.9% reported that all family members smoked.

Biomonitoring data (urinary cotinine concentrations) from 2011 also indicate widespread exposure to ETS in the adult population in Israel. In a study by the MoH, 62.2% of non-smokers had levels equal to or above the level of quantification (LOQ). Proportions equal or above the LOQ were significantly higher for males compared to females, for subjects with lower levels of education, and in the younger age group.

Based on MoH data on infant exposure to smoking, published in 2014, 25% of Jewish infants and 52% of Arab infants are exposed to ETS at two months of age.

Exposure to ETS at Age 2 Months

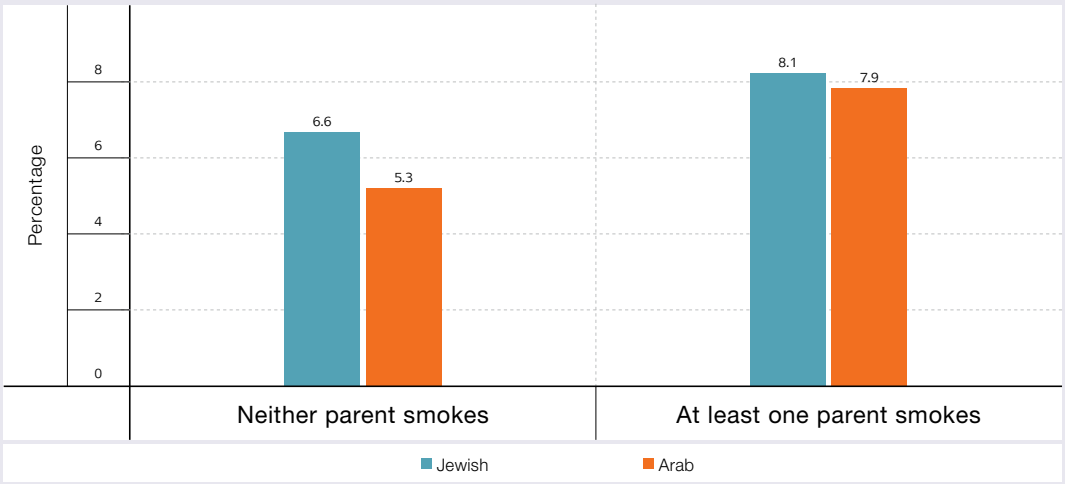
→ **Figure 1**
Source: Israeli Ministry of Health (9)



Data on Health Effects of Environmental Tobacco Smoke in Israel

There are limited data in Israel on the health effects of exposure to ETS. Data from 2008 show that incidence of atopic eczema or allergic rhinitis in children ages 13–14 was not affected by smoking by at least one family member. However, asthma was higher in children who had a parent who smoked (Figure 2).

Self-Reported Asthma in Children Age 13–14, by Parental Smoking



← **Figure 2**
Source: Israeli Ministry of Health (5)

In a study on asthma prevalence in Israeli-born children of Ethiopian origin, households reporting parental smoking had a higher asthma rate compared to households that were smoke-free.

Research on Exposure to Environmental Tobacco Smoke in Israel

- Researchers at the Technion Center of Excellence in Exposure Science and Environmental Health (TCEEH) are currently studying the indoor dynamics of different constituents of tobacco smoke, in particular nicotine and its progenies (SVOCs), and their chemical effects on molecular and enzymatic changes in saliva. Research at the Technion has shown that exposure to third-hand smoke ozonation products in the indoor environment may pose significant health risks.
- Researchers from the Helen Schneider Hospital for Women showed that the pregnancy rate in women undergoing in vitro fertilization with high quality embryos is affected by active but not passive smoking.
- Researchers from the Hebrew University–Hadassah School of Public Health and Assaf Harofeh Medical Center are currently conducting a case-control study on ETS exposure (including cotinine measurements) among children attending the emergency room with respiratory symptoms compared to a control group.
- Researchers at Tel Aviv University are studying ways to reduce child exposure to tobacco smoke, including studies on parental perceptions of childhood exposure to tobacco smoke, reviews of intervention programs to encourage parental cessation, and a randomized controlled trial of an intervention program to protect children from tobacco smoke.
- The MoH is planning to measure urinary cotinine in Israeli adults and children in 2015 to estimate exposure of non-smokers to ETS.

Progress and Challenges

- One of the major challenges in reducing public exposure to ETS is that 18.7% of the adult population in Israel smokes (data from 2013, based on self-report). According to recent data from the Organisation for Economic Co-operation and Development (OECD), Israel is ranked 12th (lowest) out of the 40 OECD countries in smoking rates.
- There are major challenges in enforcing legislation regarding smoking in public places in Israel. The MoH Report on Smoking highlights the fact that many municipalities fail to report on their activities related to prevention of smoking in public places.
- There is a discrepancy between the relatively strict legislation forbidding smoking in public places and the extensive data showing widespread exposure of the non-smoking population to ETS. While Israel was once a leader in legislation regarding smoking in public places, it now lags behind many other countries, both in legislation and enforcement.
- Further measures are needed to protect the Israeli population, especially children, from ETS. For example, schools are still not completely smoke-free in Israel.
- While asthma prevalence in children is one of the health indicators related to ETS exposure (and to exposure to ambient air pollution), national data on asthma prevalence in children are limited to periodic surveys of adolescents. National data on emergency room visits for asthma in children are limited by differences in hospital reporting, while data regarding asthma medication use in children are not collected on a national basis. In addition, data on asthma medication use, and other relevant endpoints are collected separately by the four large Health Maintenance Organizations in Israel, each of which maintains an electronic medical record database.
- The only biomonitoring data available in Israel on exposure of the general population to ETS are from a 2011 study of adults. More research should be directed at measuring biomarkers of ETS in susceptible populations, such as children and pregnant women. Biomonitoring should be used to monitor trends in exposure of the non-smoking Israeli population to ETS.
- There is no certified laboratory in Israel to analyze cotinine or other biological markers of ETS in biological samples (urine, serum, saliva).

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Chapter 4

Chemical Parameters in Drinking Water

Exposure to chemical contaminants in drinking water has been associated with an array of adverse health effects in human populations, including increased incidence of cancer (due to exposure to trichloroethylene and trihalomethanes), adverse effects on neurodevelopment (due to exposure to lead), and adverse effects on reproductive and birth outcomes (due to exposure to atrazine).

Current Regulations

The chemical quality of drinking water in Israel is regulated according to standards originally passed in 1974. The standards were revised in 1993, 2000, and most recently, in 2013. The 2013 standards include maximum contaminant levels for over 90 chemical contaminants, including metals, pesticides, radionuclides, and industrial organic pollutants. Compared to the 2000 drinking water standards, the 2013 standards require increased monitoring frequency, monitoring of 33 additional contaminants, and stricter permitted maximum contaminant levels for 28 chemicals (for examples see Table 1).

Chemicals with Lower Maximum Contaminant Levels and New Chemicals in the 2013 Standards

← Table 1

Examples of Chemicals with Maximum Contaminant Levels Added in 2013 Standards	Examples of Chemicals whose Maximum Contaminant Level was Lowered in 2013 Standards
Polychlorinated Biphenyls (industrial pollutant)	Trichloroethylene (industrial pollutant)
Ethylbenzene (industrial pollutant)	Tetrachloroethylene (industrial pollutant)
Carbofuran (pesticide)	Benzene (industrial pollutant)
Chlorpyrifos (pesticide)	Alachlor (pesticide)

The 2013 standards stipulate that the sum of each parameter measured (within a contaminant group) in the drinking water source divided by the maximum contaminant level of that parameter is not allowed to exceed 1.5. This requirement is intended to minimize exposure to chemical mixtures in drinking water.

The 2013 standards also require the Ministry of Health (MoH) to establish a permanent advisory committee to continuously evaluate international drinking water standards, evaluate data on drinking water quality in Israel, and recommend changes to existing standards. The 2013 standards cancel the existing requirement to fluoridate drinking water (as of August 2014) and require the MoH to conduct a pilot study on the feasibility of adding magnesium to desalinated drinking water.

The quality of bottled water, much like other food products, is under the supervision of the National Food Service at the MoH. Regulations from 1986 establish maximum permissible concentrations of chemical parameters in drinking water sources of bottled water. The regulations require labeling if the mineral content in the water exceeds concentrations established by the regulations.

In 2013 the MoH launched a campaign to increase public consumption of tap water in order to decrease consumption of sweetened beverages and bottled water.

Data on Chemical Parameters in Drinking Water

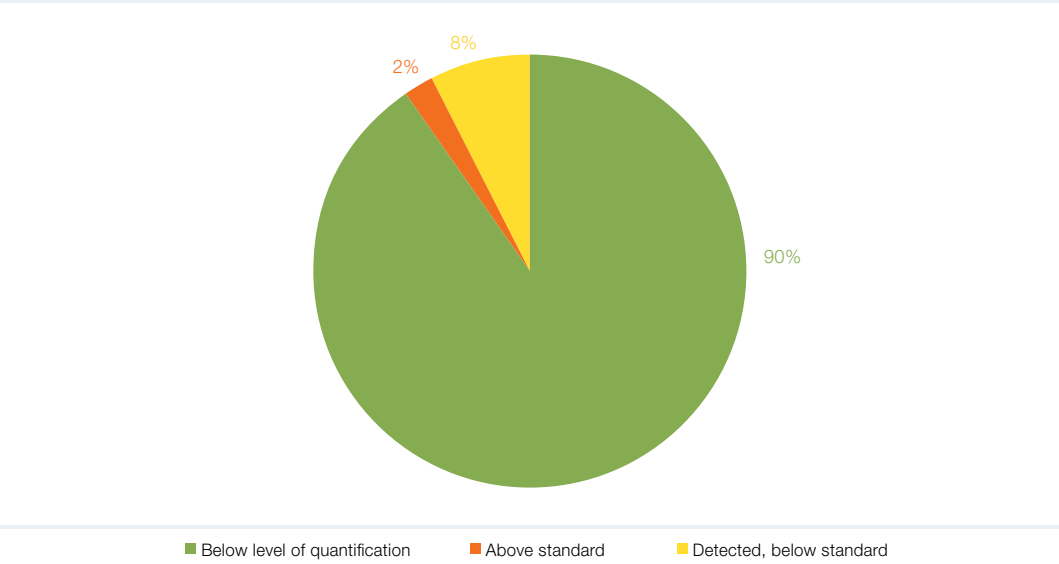
The MoH publishes annual reports on microbial and chemical water quality in drinking water sources based on reported data from drinking water suppliers. Based on data from 2009–2010, four chemical contaminants (pesticides and industrial pollutants) were detected in over 5% of drinking water sources in Israel: trichloroethylene (9.5%), tetrachloroethylene (6.9%), atrazine (13.8%), and simazine (14.1%). Chloroform was detected in 4.9% of drinking water sources. These results are consistent with data from 2006–2008. Heavy metals such as arsenic, mercury, lead and cadmium occur naturally in the environment and are detected in 2–7% of drinking water sources, usually at levels below 30% of the drinking water standard.

The MoH publishes annual reports on water quality in municipal water supplies, including data on microbial quality, concentration of heavy metals, fluorides, and chlorination by-products (trihalomethanes). Heavy metals (chromium, lead, copper, iron and zinc) are generally below the drinking water standard in monitored municipal drinking water sources. However, it is important to point out that many municipalities do not meet the requirements for monitoring heavy metals in drinking water.

The first major survey on drinking water quality in households and institutions in Israel was conducted by the MoH in 2011 following four smaller surveys in the 1990s. Of approximately 800 samples, 16 samples (2%) had lead concentrations above the standard (10 µg/L), while

an additional 8% of samples had lead concentrations that were detectable, but below the standard (Figure 1). The major conclusion of the survey was that drinking water components, such as pipes and fittings, contribute to the presence of lead in drinking water in homes and institutions. In general, there are limited data in Israel on drinking water quality in households and in institutions, such as schools.

Lead Concentration in Drinking Water in Households and Institutions, 2011



← **Figure 1**
Source: Israeli Ministry of Health (2)

One of the emerging positive trends in the quality of drinking water in Israel is the significant decrease in trihalomethane concentrations over the past 15 years, mostly as a result of the increase in supplied desalinated water in southern Israel and the subsequent decrease in staying time of water in drinking water systems. In 2005, average monthly trihalomethane concentrations measured at different points along the National Water Carrier were as high as 132.6 µg/L (compared to the drinking water standard of 100 µg/L). In 2012, average monthly trihalomethane concentrations measured at different points along the National Water Carrier were below 60 µg/L.

The Water Authority's Water Quality Division regularly monitors groundwater affected by contamination sources, such as industry, gas stations, waste sites, and agricultural sites. The Division monitors contaminants which are not included in the drinking water standards. The Division has detected widespread gasoline contamination in the Mountain Aquifer and has detected chlorinated solvents and heavy metals in groundwater around selected industrial areas. The Division has recently begun to monitor endocrine disrupting chemicals, pharmaceuticals, and hormones in groundwater.

In 2010–2011 the MoH conducted a pilot survey on bisphenol A (BPA) in bottled water in polycarbonate containers. Water samples were collected from new and used polycarbonate containers. BPA was not detected in any of the samples.

Research on the Chemical Quality of Drinking Water in Israel

There have been very few published studies on the chemical quality of drinking water in Israel. In 2010, researchers from the Hebrew University of Jerusalem, the Water Authority, and Mekorot – Israel National Water Company, published findings showing that the organic drug carbamazepine can be used to accurately estimate the probability that a drinking water well has been contaminated by wastewater.

Progress and Challenges

- As a result of the 2013 Drinking Water Standards, there has been major progress in increasing transparency and timely reporting of data on drinking water quality. The MoH website includes quarterly results on the microbial and chemical quality of drinking water in water sources and in municipal water supplies. The website also includes a database with information on health effects of drinking water contaminants currently regulated in Israel.
- The new Drinking Water Standards partially address the issue of chemical mixtures by requiring that total chemical parameters within a contaminant group (pesticides, metals, or industrial organic pollutants) relative to each maximum contaminant concentration not exceed 1.5. This is an important precedent for environmental health policy in Israel.
- By 2015, 30% of the drinking water in Israel is expected to be desalinated. Reductions in intake of magnesium due to the introduction of desalinated water could potentially increase risks for various adverse health effects, for example cardiac abnormalities and hypertension. Given the increasing dependence on desalinated water in Israel, further research is needed to monitor the impact of desalination on calcium and magnesium intake and on public health in general.
- As of August 2014, fluoridation will not be required by law. The impact of discontinued fluoridation on dental health, especially in children from lower socioeconomic groups, will be evaluated.
- To date in Israel, there are no regulations or standards which limit the content of lead and other metals in pipes, faucets, and other materials that come in contact with drinking water. This is in contrast to US legislation and a voluntary program in selected European countries (Germany, France, England, the Netherlands). According to current regulations, materials in contact with drinking water are tested according to Israeli standard 5452, which tests migration of metals from new products. The MoH is currently working with representatives from the Standards Institution of Israel and with industry representatives to develop a standard that will limit the lead content of materials in contact with drinking water.
- The herbicides atrazine and simazine are present in approximately 14% of drinking water sources in Israel, albeit in concentrations that are far below the current standard. Despite decisions by the Ministry of Agriculture and Rural Development to reduce agricultural and municipal use of atrazine and to ban agricultural use of simazine, these chemicals and their breakdown products are expected to persist in drinking water sources in Israel for decades.

Atrazine is a suspected endocrine disrupting chemical which has been associated with pre-term delivery and intrauterine growth retardation; however, the health effects of widespread exposure to this chemical in drinking water in Israel have not been studied.

- There is no central database in Israel on emerging drinking water contaminants, such as unregulated chlorination by-products, and pharmaceuticals in drinking water, such as carbamazepine.

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Chapter 5

Pesticides

There is considerable evidence that acute and chronic exposure to pesticides is harmful to human health, especially to the digestive system, the respiratory system, the endocrine system (due to exposure to atrazine, for example), and the central nervous system (due to exposure to organophosphates). Some pesticides have also been linked to cancer, (carbaryl, for example). Epidemiological studies indicate that developing fetuses, infants, and children are particularly sensitive to pesticides.

Current Regulations

Four government entities approve pesticides in Israel, in accordance with their intended use: agricultural use in plants (Plant Protection Services, Ministry of Agriculture and Rural Development – MoAg); veterinary use (Veterinary Services, MoAg); sanitation (Ministry of Environmental Protection – MoEP); and use in contact with the human body (Ministry of Health - MoH). In each of these entities, there is an inter-ministerial advisory committee including representatives of the MoH, MoEP, MoAg and the Ministry of Economy (MoE).

The inter-ministerial committee that approves pesticides for agricultural use also includes a representative of the public. The role of these committees is to assess the safety of proposed pesticides from the perspective of human health and the environment, and to recommend uses and restrictions or to prohibit use. The Director of Occupational Safety and Health at the MoE is responsible for occupational safety related to pesticide manufacture and use.

Agricultural and Veterinary Use

Two key regulations address the import and sale of pesticide formulations for use in plant protection (1994) and veterinary use (1982, currently under revision). Additional regulations require that pesticide applicators act in accordance with all restrictions and guidelines appearing on officially approved pesticide labels.

Additional regulations under the authority of the MoEP and the MoAg from 1979 address the minimal distance from homes and roads that must be observed during aerial pesticide applications. Regulations from 2005 address the minimal distance from homes and roads that must be observed during ground pesticide applications. Both regulations are currently under revision.

Phased Out or Restricted Pesticides in Plant Protection, 2012-2014

→ Table 1

Pesticide Group	Substance	Phased Out	Limited to Critical Uses
Organophosphate	Azinphos methyl	X	
	Acephate	X	
	Parathion methyl	X	
	Fenthion*	X	
	Oxydemethon methyl*	X	
	Prothiophos*	X	
	Cadusafos	X	
	Diazinon*	X	
	Dichlorvos*	X	
	Metamidophos*	X	
	Methidathion*	X	
	Fenamiphos		X
	Pirimiphos methyl		X
	Ethephon		X
	Tolclophos methyl		X
	Chlorpyrifos		X
	Malathion		X
	Dimethoate		X
Triazine	Simazine	X	
	Ametryne	X	
	Atrazine		X
	Prometryn		X
	Terbutryn		X
Carbamate	Aldicarb	X	
Organochlorine	Endosulfan **	X	

* Limited to critical uses in 2012; use is prohibited as of March 2014

** Limited to critical uses in January 2013; will be prohibited as of April 1, 2015 – in accordance with the Stockholm Convention

In May 2003, in order to promote sustainable development, the government directed the MoAg to reduce use of pesticides and to develop targets and indices for assessing the effectiveness of this effort. In May 2010, the MoAg published a strategic plan for sustainable agriculture which includes a policy for reducing the number of approved pesticides and the amounts of applied pesticides. Promotion of methods like biological pest control and integrated pest management are expected to reduce pesticide use. In addition, a number of pesticides have been phased out in recent years (Table 1) and this trend is expected to continue.

Table 1 lists the active ingredients that have been prohibited or limited to critical uses in recent years. Carbamate pesticides were re-evaluated in 2014 and 3 additional active ingredients will be phased out (carbaryl, benfuracarb, and carbosulfan).

Pesticide Residues

Permitted pesticide residue levels are established in three regulations and/or ordinances.

- Regulations on permitted pesticide residues (1991) are under the joint responsibility of the MoH and the MoAg. In 2011, the Supervision of Plant Production and Marketing Law came into effect (under the purview of the MoAg). Efforts are currently underway to implement regulations that will facilitate tracing pesticide residues in food back to the grower.
- Regulations from 1971 (under the purview of the MoAg) which address the issue of animal feed are expected to be replaced in 2014 by new legislation which will regulate permitted levels of pesticides in animal feed, and will require tracing the path of food to the animal and from the animal to human beings.
- Regulations from 2000 address permitted pesticide levels in animal-based food. These regulations are under the authority of the MoAg. The permitted residue levels are determined in cooperation with the National Food Service (MoH).

Sanitation

Regulations from 1994 that are based on the Hazardous Materials Law address the issue of pesticide formulations for sanitation use. Regulations from 1975 address pesticide applicators. New legislation on pesticide applicators was submitted to the Knesset in 2014. The Pest and Pest Control Division at the MoEP is responsible for ensuring that only licensed pesticide applicators engage in sanitation pest control, that they use only permitted substances, and that these substances be applied in accordance with the products' labeled instructions.

In 2007, the MoEP prohibited household use of pesticides that contain organophosphates, chlorpyriphos and diazinon. Two years later, the MoAg expanded the restriction on chlorpyriphos and diazinon to prohibit use in public and private gardens, parks, and in certain veterinary applications.

Substances in Contact with the Human Body

Only one percent of pesticide formulations registered in Israel are for medical purposes (for example, lice treatment). The Pharmacy Department at the MoH is responsible for overseeing chemical preparations for the control of pests harmful to human beings. Their authority is based on an ordinance from 1962.

Data on Pesticide Use and Exposure

Pesticide Residues

The MoAg is responsible for sampling pesticide residues in food during the growing and packaging stage, while the MoH is responsible for sampling the produce during the sales and marketing stage. Ordinarily there is no overlap between the sampling performed by the two ministries who do coordinate their efforts. Any irregular result found in the market is passed on to the MoAg for further investigation.

The National Food Service at the MoH samples 800 to 1,000 items annually in accordance with its annual plan. The Plant Protection and Inspection Services has an annual program for field sampling and inspection of agricultural produce intended for the local market, with about 700 tests conducted each year. The Veterinary Services publish an annual report, which is available online, on residues found in animal products.

A risk assessment published by the National Food Service in 2013 summarizes data on exposure to pesticide residues in food from 2006 to 2010, as sampled by the MoAg and MoH. Over 5,500 samples were tested in over 100 different food products. In 625 samples, which comprise 11.2% of all samples, pesticide residues were found in excess of the maximum permitted residue level. It is important to note that the risk assessment uses theoretical calculations of the adult Israeli diet based on market data.

In 2011–2012, the MoH tested over 1,300 food samples; pesticide residues in excess of the maximum permitted residue level were found in 13.5% of the samples. The findings are available on the National Food Service website. In 2011–2012, the MoAg Plant Protection Services tested about 1,500 plant samples; pesticide residues in excess of the maximum permitted residue level were found in about 6% of the samples.

In the Veterinary Services (MoAg) annual survey of pesticide residues in animal products in 2011–2012, 14 types of products from eight different types of animals were tested. More than 2,000 samples were tested for pesticide residues; no excess level of pesticide residues was found in any of the samples.

Data on Registered Pesticide Formulations

An estimated 72% of all pest control formulations in Israel are used in plant agriculture and about 13% are for veterinary use (primarily for farm animals, but also for pets). As of the second half of 2014, there are 386 active ingredients permitted for use in agricultural pest control in Israel. In Europe by comparison, there are 449 active ingredients used as agricultural pesticides. No maximum permitted residue level has been defined for 130 of the active ingredients registered in Israel – either because the method of using them ensures that no residue will be found in the produce or because no level of residue in the produce is

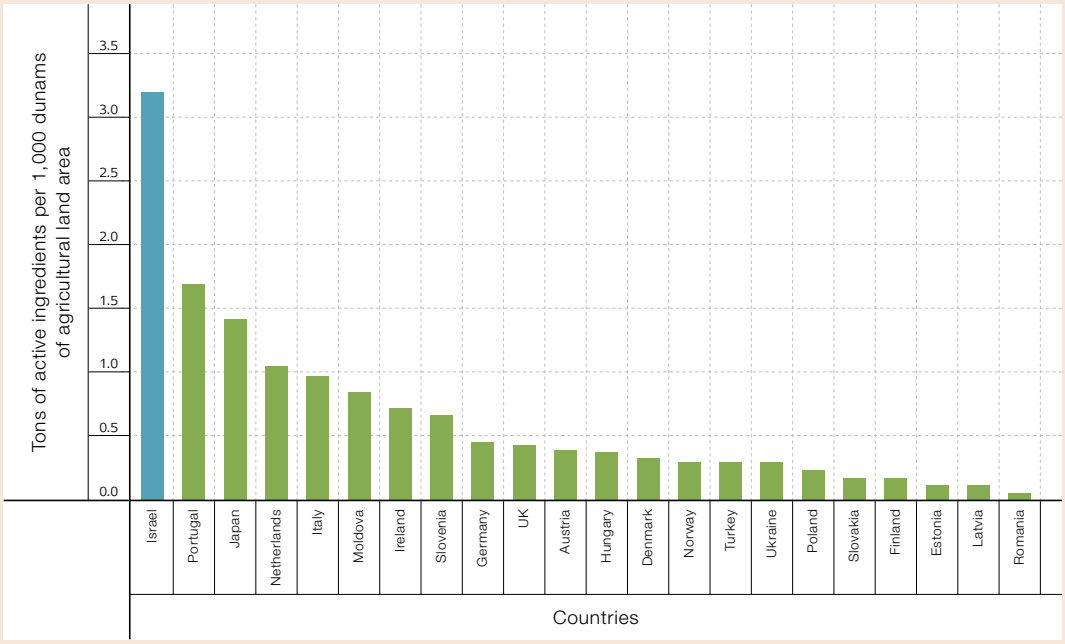
permitted. In 2010, maximum permitted residue levels were defined for 269 active pesticide substances as well as six additional substances that were used in the past and are still defined as environmental pollutants.

Approximately 14% of all pesticides in Israel are used for sanitation purposes. As of 2013, only 13 active ingredients were categorized as pesticides for medical purposes, including eight active ingredients for repelling mosquitoes and five active ingredients for treating lice.

Data on the Scope of Use and Exposure to Pest Control Substances

Israel is the record-holder among selected Organisation for Economic Co-operation and Development (OECD) countries in the use of pesticides. According to data from the Israel Central Bureau of Statistics, 3.2 tons of active ingredients were used in Israel in 2010 per 1,000 dunams of agricultural land (Figure 1).

Tons of Active Pest Control Substance Per 1,000 Dunams of Agricultural Land for Selected Countries



← **Figure 1**
Source: Israeli Central Bureau of Statistics (2)

From 2008 to 2010, 6,600–7,300 tons of active pesticide substances were sold in Israel. During this period, there were only slight fluctuations in the amount of organophosphate pesticides sold. During 2008–2010, there was an increase of 8% in sales of active pesticide substances for sanitation.

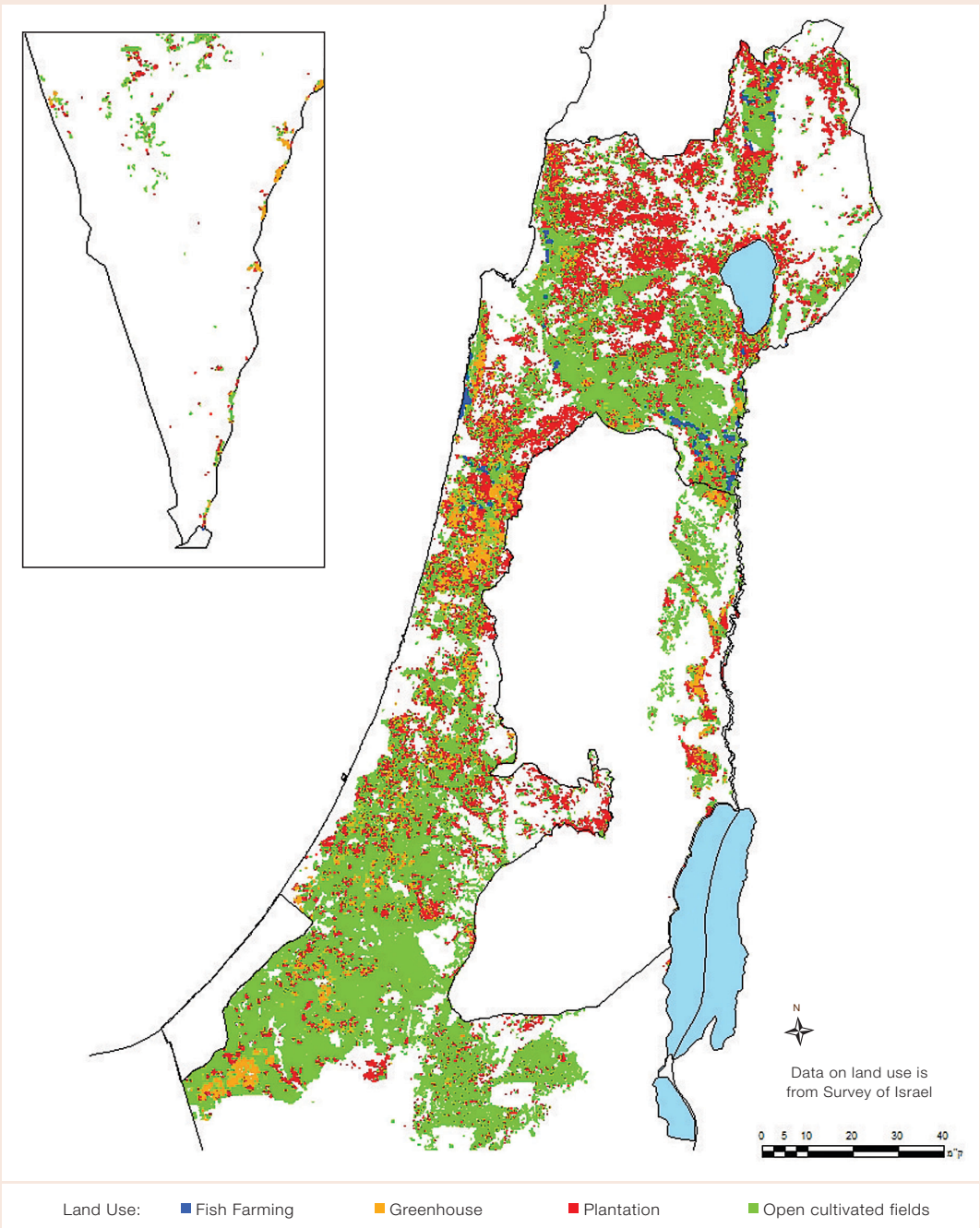
The sale of pesticides for veterinary use rose from 11 tons in 2008 to 20 tons in 2010, an increase of more than 80%. Most of this increase is attributed to the use of veterinary pesticides for pets and for the poultry sector.

Data on Geographic Proximity of the Population to Agricultural Areas

In 2013, the extent of cultivated agricultural land in Israel was 4.2 million dunams (including buildings and farm roads), which comprises 19% of the total area of the country. A significant part of the cultivated land is near settled areas, with 13% in urban localities. Figure 2 indicates the proximity of population centers to agricultural land where pesticides are used.

Agricultural Land Use in Israel

→
Figure 2
Source: Israeli Ministry of Agriculture and Rural Development



Biological Monitoring of Organophosphate Metabolites

A survey conducted by the MoH and published in 2013 measured exposure of the adult population in Israel to organophosphate pesticides, which have been linked to a range of negative effects on human health. Six organophosphates metabolites (dialkylphosphates) were measured in urine samples. Dialkylphosphates were detected in each of the samples, with increased concentrations among individuals who reported higher consumption of fruits. The study found that exposure of the general population in Israel to organophosphates is higher than that of the general population in either the US or Canada. For more information on the results of this survey, see the Chapter on Biomonitoring.

Data on Pesticide Poisoning

The Beterem organization published a report on childhood pesticide poisoning in the period from 2008 to 2013. The data indicate that nearly 75% of the affected children were four years old or younger. Most of the cases occurred among Arab children, particularly Bedouins. The data indicate that most of the incidents occurred at home or adjacent to the home. According to data from the Israel Poison Information Center at Rambam Hospital there were over 550 cases of pesticide poisoning in 2013.

Research on Health Effects of Pesticides in Israel

- Researchers from the Hebrew University Center of Excellence in Agriculture and Environmental Health in collaboration with the National Food Service at the MoH are studying childhood exposure to pesticides in Israel. The study found that exposure of children ages four to seven is high compared to that of adults.
- Researchers from the Hebrew University Center of Excellence in Agriculture and Environmental Health are studying the impact of organophosphate pesticides on the endocrine system and on fetal development.
- Researchers from the Hebrew University Center of Excellence in Agriculture and Environmental Health are studying the levels of organophosphate metabolites in agricultural products with the aim of determining the sources of organophosphate metabolites found in urine samples from the general population.
- Researchers from Hebrew University of Jerusalem and Shaare Zedek Medical Center are studying the long-term health effects of environmental exposure to pesticides in children and adults in kibbutzim, such as the impact on the peripheral nervous system and on cognition.
- In 2015, the MoH plans to measure organophosphate metabolites in urine from a representative sample of adults and children in order to determine whether policy to reduce agricultural use of organophosphates has been effective in reducing public exposure.

Progress and Challenges

- Between 2012 and 2014, the MoAg phased out 18 active ingredients and limited the use of 10 additional active ingredients of organophosphate, triazine, carbamate and organochlorine pesticides.
- In early 2014, the MoEP submitted new legislation to the Knesset addressing training and licensing of pesticide applicators. In addition, the MoEP is currently updating regulations that limit aerial and ground application of pesticides near residences. Enactment of this legislation and the institution of new regulations is expected to improve the regulatory framework for pesticide use in Israel.
- There are four inter-ministerial committees responsible for providing recommendations on pesticide registration. The State Comptroller, in his annual report, noted in 2002 and 2011 that consideration should be given to merging these committees in order to ensure uniform criteria for pesticide registration. As of 2014, unification of the committees has not been implemented.
- Because of concerns regarding potential negative health effects, the inter-ministerial committees are developing a list of permitted co-formulants in pesticide formulations.
- There are major challenges in enforcement of proper pesticide use in Israel. The State Comptroller's Report from 2011 addresses this issue at length, including the challenges involved in supervising the sale and use of agricultural pesticides in residential settings. Illegal use of an agricultural pesticide (phosphine) in a residential building in Jerusalem in 2014 led to the death of two children and the injury of two additional children from the same family.
- There is a need for data and monitoring regarding public exposure to pesticides. Such monitoring is needed in areas where there is geographic proximity between the treated agricultural areas and population centers, with an emphasis on sensitive populations (kindergartens, schools, etc.). The MoH will monitor the impact of policy to reduce public exposure to organophosphate pesticides by continuing to test for pesticide residues in agricultural produce and by using biomonitoring.
- Today, there is no database in Israel on poisoning from pesticides. At the Israel Poison Information Center at Rambam Hospital, data are collected on calls to the Center regarding poisoning. These data do not fully reflect the scope of pesticide poisoning due to incomplete reporting.

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Chapter 6

Chemical Food Contaminants

Chemical food contaminants, or "food pollutants", refers to substances that are unintentionally added to food and whose presence derives from pollution during the process of growing, producing, processing, preparing, handling, packing, transporting, storing or maintaining food. These pollutants can be industrial and/or environmental contaminants (such as heavy metals, dioxins, or PCBs), natural toxins (such as mycotoxins), or toxins that are created during processing (such as acrylamide). This chapter primarily addresses those chemical food contaminants specifically defined as "food pollutants" and additional substances such as food contact materials, antibiotics, and hormones.

Exposure to food pollutants is linked to a wide range of acute and chronic negative health effects, including impacts on cognitive development (heavy metals), cancer (mycotoxins and dioxins), and damage to the reproductive system (dioxins). Long-term exposure to food pollutants – even at very low concentrations – can have negative health effects, particularly among sensitive sub-populations (pregnant women, children, and the elderly).

Current Regulations

Current food pollutant regulations date from 1958 and 1983. Specific standards, regulations, and guidelines have been developed for those foods that are likely to have high concentrations of contaminants. These regulations, including those for mercury content in fish (1979), are due to be updated in 2014. In addition, specific regulations on mycotoxins in food (1996) and specific guidelines for heavy metals, melamine, polycyclic aromatic hydrocarbons (PAHs), and radionuclides in food were updated in 2013.

Maximum levels of contaminants in food are determined in accordance with the "as low as reasonably achievable" (ALARA) principle and the risk assessments conducted by the Risk Management Unit of the National Food Service at the Ministry of Health (MoH). The main parameters for determining maximum levels of contaminants are risk assessments and recommendations and regulations from international organizations such as the World Health Organization (WHO) (the Codex Alimentarious Commission), the European Union, and the US Food and Drug Administration. The MoH conducts supervision and enforcement in accordance with its authority, including destroying food that is deemed dangerous for consumption.

Regulations from 1977 restrict use of potentially hazardous materials in food containers and include specific restrictions regarding the use of polyvinyl chloride in food containers.

Regulations from 2004 passed by the Ministry of Environmental Protection (MoEP) establish maximum bacterial levels and heavy metal content of sludge, including sludge applied to agricultural land where produce for human consumption is grown. Regulations from 2010 (passed by the MoH and the MoEP) establish maximum bacterial levels and heavy metal content of treated wastewater used for agricultural irrigation.

Data on Chemical Food Contaminants

The MoH routinely samples imported food products at quarantine stations. Products that are more sensitive to food contaminants or in which excess levels of contaminants have been found in the past are inspected more frequently than products that are less sensitive to these pollutants. In addition, ongoing monitoring of mycotoxins is conducted in the framework of an annual sampling program. Testing for other food pollutants is conducted in periodic surveys, based on risk evaluation. If the survey shows an excess level of contaminants, sampling is expanded as needed. The Veterinary Services at the Ministry of Agriculture (MoAg) conduct annual surveys of animal products according to regulations from 2000. A professional steering committee coordinated jointly by the MoH and the MoAg determines the structure of the surveys. The summaries of the findings from the various surveys are available to the public on each ministry's website.

In 2013, the MoH in conjunction with the MoAg conducted a follow-up survey on the presence of dioxins, furans, and PCB-like dioxins in food. One hundred and ten samples of animal products and ten samples of animal feed were tested. Low or very low levels of the substances (up to one picogram per gram of fat) were detected in 87% of the samples. The average level of dioxins found relative to the maximum permitted level was 16.3% in milk and milk products, 3.4% in fish, 11.8% in meat and in beef fat, 6.4% in beef liver, 33.1% in chicken liver, and 72% in eggs. Overall dietary exposure was calculated at 56.2% of the tolerable intake as established by the WHO (120 pg/day for 60 kg adult). Compared to the previous survey results from 2008, there was a significant decrease in the level of exposure to dioxins, furans, and PCB-like dioxins from food

in Israel. The joint survey in 2013 by the National Food Service and MoAg found high levels of dioxins in sampled eggs at 2.2 times the maximum permitted level. In the wake of these findings, additional testing, and an assessment of health risks, the MoH decided to halt the marketing of eggs from four suspected chicken farms.

In addition, it was decided to expand the testing of eggs, as well as testing of animal feed from various farms. The annual plan of the National Food Service also includes an additional survey of dioxins in all animal food products, using Chemical Activated Luciferase Gene Expression Assays.

The MoAg and the National Food Service at the MoH are currently examining the sources of dioxin contamination in food by testing samples across the food chain. The results of the study are likely to indicate those points along the production chain that can be improved in order to reduce the levels of dioxins and PCBs in food.

In the annual survey published by the Veterinary Services for 2011–2012, animal products from eight types of animals were tested for chemical food contaminant residues. Of the samples tested, 11 (1.8%) contained cadmium (in liver) above the maximum permitted level. Higher-than-permitted levels of aflatoxins were found in 25 (4.3%) of the 573 milk samples tested. The survey did not find levels of PCBs, lead, or mercury above the maximum permitted level in any of the tested samples. Results on arsenic levels were not reported. Pollutants were found in some of the samples: lead in milk products (3%); mercury in fish (58%); and cadmium in chicken liver (46%).

Hormones, including diethylstilbestrone, estradione, estradiol, and progesterone were tested in various samples of fish, poultry, and milk and none were detected in any of the samples. Pharmaceuticals were detected at above the permitted residue levels in more than 2% of samples for: tetracycline in sheep (6/230), ionophores in chicken (7/240), nicarbazin in chicken (8/300), sulfonamides in turkey (3/142), clopidol in eggs (54/300), ionophores in eggs (54/274), and tetracycline in eggs (5/170). In general, pharmaceutical compounds were detected at levels below the maximum permitted. Levels above the maximum permitted were detected in fewer than 1% of samples.

The National Food Service conducts ongoing monitoring of mycotoxins in food sold in Israel, in accordance with an annual plan and via the health bureaus of the MoH. Between the years 2008–2012, over 1,600 samples were analyzed so as to identify and quantify aflatoxins and ochratoxin A. It should be emphasized that the samples were collected from food that was defined as potentially containing mycotoxins (spices, legumes, cereals, nuts, and milk). In general, excessive levels of mycotoxins were found primarily in spices, especially in paprika. A re-evaluation is currently underway on lowering the maximum permitted levels for some mycotoxins and for defining maximum permitted levels for additional mycotoxins and additional categories of food.

Data on Chemical Contaminants in Treated Wastewater and Produce Irrigated with Treated Wastewater

According to a Water Authority Report from 2009, based on measurements in 11 different wastewater treatment plants, the main chemicals detected in wastewater were pharmaceutical compounds (primarily carbamazepine) and the flame retardant trichloroethyl phosphate.

A 2012 survey of leafy vegetables and root vegetables irrigated with treated wastewater, conducted by the MoH in cooperation with the Hebrew University of Jerusalem showed that the pharmaceutical carbamazepine was detected in about 30% of samples. Levels were between 0.35 and 12.4 µg/kg. Pharmaceutical compounds were not detected in crops irrigated with drinking water. Carbamazepine and additional pharmaceutical compounds (for example, diclofenac and naproxen), as well as pesticides and flame retardants (including tris [3-chloropropyl] phosphate) were detected in wastewater samples. Bisphenol A (BPA) was not detected in any of the wastewater samples. In a 2011 survey of vegetables including carrots, onions, tomatoes and cucumbers, carbamazepine and triclosan were detected in 7 out of 27 samples. BPA and hormones (such as estrone, estriol and testosterone) were not detected in any of the samples.

Research on Chemical Contaminants in Food

Researchers at the Hebrew University of Jerusalem have published studies on plant uptake of pharmaceutical compounds from wastewater, including studies on carbamazepine uptake by cucumber plants using different soil types irrigated either with fresh water or reclaimed wastewater. Numerous research groups in Israel are studying the removal of pharmaceuticals and other compounds during the wastewater treatment process.

Progress and Challenges

- The methodology of the joint survey conducted by the MoH and the MoAg for examining animal-based food products was improved in 2012 and consequently the number of samples taken and the statistical power of the survey increased significantly.
- Legislation on animal feed was recently updated to address issues related to the inspection and control of manufacturing animal feed, including testing for animal feed contaminants that might be passed on to humans.
- The use of animal waste as fertilizer in agriculture is currently being jointly evaluated by the MoAg and the MoH. Control and supervision will be introduced as part of regulations for using organic waste in agriculture in order to address the issue of pollutants originating in untreated animal waste that can reach humans via contaminated agricultural produce.

- Biosolids (treated sewage sludge), and coal ash (coal combustion residuals), both of which are applied on agricultural land used to grow crops for human consumption, can potentially contain low levels of contaminants, including heavy metals, pharmaceuticals, and radiation. The MoH is evaluating levels of heavy metals and radiation in crops treated with coal ash.
- Over 75% of the domestic wastewater in Israel is recycled, mostly for agricultural use. There are currently no regulations or guidelines that address permitted levels of pharmaceuticals and other contaminants in water used for irrigation. Issues pertaining to the presence of pollutants in irrigation water such as well water, water from fishponds, and gray water are currently being re-evaluated.
- Although aluminum was not considered a toxic metal in the past, recent studies indicate a link between long-term consumption of high levels of aluminum and a negative impact on cognitive health endpoints. The National Food Service at the MoH is currently evaluating possible adverse health outcomes associated with aluminum exposure, with an emphasis on infant food. A wide range of baby foods will be tested for the presence of aluminum.
- During the years 2010–2013, the National Food Service at the MoH conducted surveys on the presence of heavy metals and dioxins, furans, and PCBs in food. In 2014, the National Food Service will test for the presence of polycyclic aromatic hydrocarbons in various food products. The Food Service plans to repeat a survey conducted ten years ago on phthalates in infant food and to continue to analyze mercury content in fish.

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Chapter 7

Chemicals in Consumer Products

Exposure to chemicals in consumer products has been associated mostly with acute health outcomes, such as lead poisoning following ingestion of toys and lead contaminated paint. In addition, there is evidence that consumer products contribute significantly to overall exposure to endocrine disrupting chemicals (EDCs) such as phthalates, flame retardants, and triclosan.

Current Policy and Standards

In Israel the only consumer products that undergo a formal registration process, as mandated by legislation, are pesticides, pharmaceuticals, and personal care products. As discussed in the chapter on pesticides, pesticides for household, agricultural and garden use, or for use on pets, are registered by the Ministry of Environmental Protection (MoEP) and the Ministry of Agriculture and Rural Development (MoAg). The Ministry of Health (MoH) registers pharmaceuticals, personal care products, and pesticides in direct contact with the body, such as mosquito sprays and formulations for lice treatment.

The MoH adopted European policy on cosmetic products from 2009 prohibiting many chemicals for use in cosmetic products, including lead, arsenic, benzene, dibutyl phthalate, diethylhexyl phthalate, and benzyl butyl phthalate. Formaldehyde is permitted in nail hardening products at a concentration up to 5%.

The MoH also registers medical equipment according to the Medical Equipment Law enacted in 2012. In July 2013, the MoH published a notice stating that all pharmacies must stop selling thermometers

and sphygmomanometers containing mercury by the end of 2014, and that hospitals and clinics must phase out mercury containing thermometers and sphygmomanometers over the course of 2014.

There are numerous Israeli standards addressing the chemical content of consumer products, mainly those used by infants and/or children or those in contact with food. These standards, which fall under the auspices of the Ministry of Economy (MoE) are generally based on, or adopted from, international standards. According to the Standards Law, the MoE can declare that a standard is mandatory if the standard is required to protect public health, safety, or the environment. If a mandatory standard applies to a product, that product cannot be produced, sold, imported, or exported unless the product meets the requirements of the standard.

The following table (Table 1) lists the major Israeli standards relating to chemical contaminants in consumer products and notes whether the standards are mandatory or voluntary.

→ Table 1

Israeli Standards Addressing Chemical Contaminants in Consumer Products

Standard Number	Product	Contaminants	Mandatory or Voluntary
562	Toys	Heavy metals, phthalates	Mandatory
1498	Playground equipment	Heavy metals, phthalates	Mandatory
5817	Baby bottles and drinking containers	Heavy metals, bisphenol A, nitrosamines, 2-Mercaptobenzothiazole, antioxidants	Mandatory
14372	Eating utensils for children	Heavy metals, bisphenol A, phthalates, nickel	Voluntary
1157	Pacifiers	Nitrosamines and volatile organic compounds	Mandatory
12586	Pacifier holders	Heavy metals, primary aromatic amines, phthalates, nickel, monomers	Mandatory
1637 809 1945 756 539	Paints	Heavy metals	Voluntary
1084	Wood products	Formaldehyde	Mandatory (partial)
1003	Ceramic-ware in contact with food	Heavy metals (lead and cadmium)	Mandatory
1003	Glassware in contact with food	Heavy metals (lead and cadmium)	Voluntary
1003 part 2	Vitreous and enameled metal-ware in contact with food	Heavy metals (lead and cadmium)	Voluntary
5113	Plastic materials in contact with food	Total migration, Bisphenol A, formaldehyde	Mandatory
1104	PVC packages for food, pharmaceuticals and personal care products	Vinyl chloride monomer	Mandatory
5452	Equipment in contact with drinking water	Heavy metals, genotoxicity	Mandatory (based on Drinking Water Regulations)
5562	Metal products in contact with human body (e.g. earrings, watches)	Nickel	Mandatory

In addition to the above standards which specifically address chemical contaminants in consumer products, there are various standards which address labeling and packaging requirements for dangerous chemicals and cleaning products. There are also numerous standards relating to flame resistance of mattresses (including those for infants) and other products, such as couches, infant pajamas, and bed frames. While these standards do not explicitly require the use of flame retardant chemicals, the strict requirements for flame resistance de facto require the use of flame retardant chemicals. The flame resistance standard for infant mattresses is mandatory. The status of the flame resistance standard for mattresses other than infant mattresses is currently under debate.

During 2010–2014, a number of these standards underwent revision, specifically with regard to chemicals contaminants:

- The standard for toys was revised to require quantitative testing for phthalates and is undergoing revision to expand the number of tested metals and other compounds.
- The standard for baby bottles and drinking containers was revised to require a declaration by the manufacturer that bisphenol A (BPA) was not used in the production of the bottle (in addition to quantitative testing of BPA). The revised standard has not yet been approved by the MoE.
- The standards for lead and cadmium in ceramic-ware in contact with food was revised to include cookware with a ceramic coating and glass ware in contact with food, and are voluntary.

Data on Chemicals in Consumer Products

There are limited available data in Israel on chemicals in consumer products. In a survey on phthalate content of imported toys conducted at the Hebrew University of Jerusalem, seven out of 40 samples purchased on the Israeli market did not comply with European standards. The phthalates most frequently detected at levels above the standard were DEHP and DINP. Data from the Standards Institution of Israel show that for up to 60% of tested polyvinyl chloride toys, the phthalate content exceeded that required by the Israeli standard. In addition, 10-15% of ceramic-ware tested for metals exceeded the standard; while for plastic containers in contact with food 10% exceeded the standard for total migration.

Research on Exposure to Chemicals in Consumer Products

- Researchers at Assaf Harofeh Medical Center, Tel Aviv Sourasky Medical Center and at Columbia University, NY are exploring predictors of exposure to phthalates and brominated flame retardants in pregnant women, including contact with consumer products.
- Researchers at the MoH are exploring predictors of exposure to phthalates in the general population, including use of personal care products.

Progress and Challenges

- The new Israeli cosmetics regulation (which has yet to be approved by the Knesset) states specific requirements regarding use of nano-materials and prohibits the use of toxic ingredients listed as carcinogenic, mutagenic, or toxic for reproduction according to the European Cosmetics Directive.
- There are very limited available data on the chemical content or contamination of consumer products. For most products, there is no labeling requirement on the product itself to inform the consumer whether the product meets the relevant standard. This is however available on the Standards Institution of Israel website. For consumer products such as pharmaceuticals and personal care products, there is no requirement to label content of chemicals such as phthalates and triclosan. Pharmaceuticals and personal care products do require labeling stating that the product has been approved by the MoH.
- Since the MoE is currently responsible for determining whether standards are voluntary or mandatory, there is a need to re-evaluate the MoH role in guaranteeing implementation of health protective standards.
- Enforcement of official standards regarding chemical contaminants in consumer products should be a priority. The limited enforcement efforts that do exist are focused on imported consumer products, not locally produced goods. In 2011, the State Comptroller described considerable challenges regarding supervision of imported toys with regard to the requirements in Standard 562. The recent addition of 30 inspectors at the MoE is expected to improve enforcement of official standards regarding chemical contaminants in imported consumer products.

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Chapter 8

Biomonitoring

Biomonitoring has many uses in the field of environmental health, including evaluation of exposure to environmental chemicals on the individual level, detection of changes at the cellular/molecular level prior to clinical diagnosis, establishment of baseline levels of exposure in the general population, comparison of exposure to environmental chemicals among different populations, and assessment of effectiveness of policies intended to reduce exposure to specific chemicals. National biomonitoring programs have been developed in many countries, including the US, Canada, France, Belgium, and Germany.

Current Regulations

As in most European countries, there is no legislation in Israel requiring human biomonitoring in the general population. The National Nutrition and Health Survey (MABAT), which could serve as a platform for human biomonitoring in Israel, is not required to do so. Occupational biomonitoring in Israel is mandated by law for workers potentially exposed to metals (cadmium, lead, arsenic, chromium, mercury, cobalt, and nickel), organophosphate and carbamate pesticides (cholinesterase monitoring in red blood cells), aromatic hydrocarbon solvents (benzene, toluene, styrene, and xylene), and halogenated solvents (trichloroethylene, perchloroethylene, and 1,1,1-trichloroethane).

Data on Human Biomonitoring in Israel

Between 2010 and 2013 there were two major biomonitoring studies conducted in Israel:

Persistent Organic Pollutants (POPs) in Breast Milk

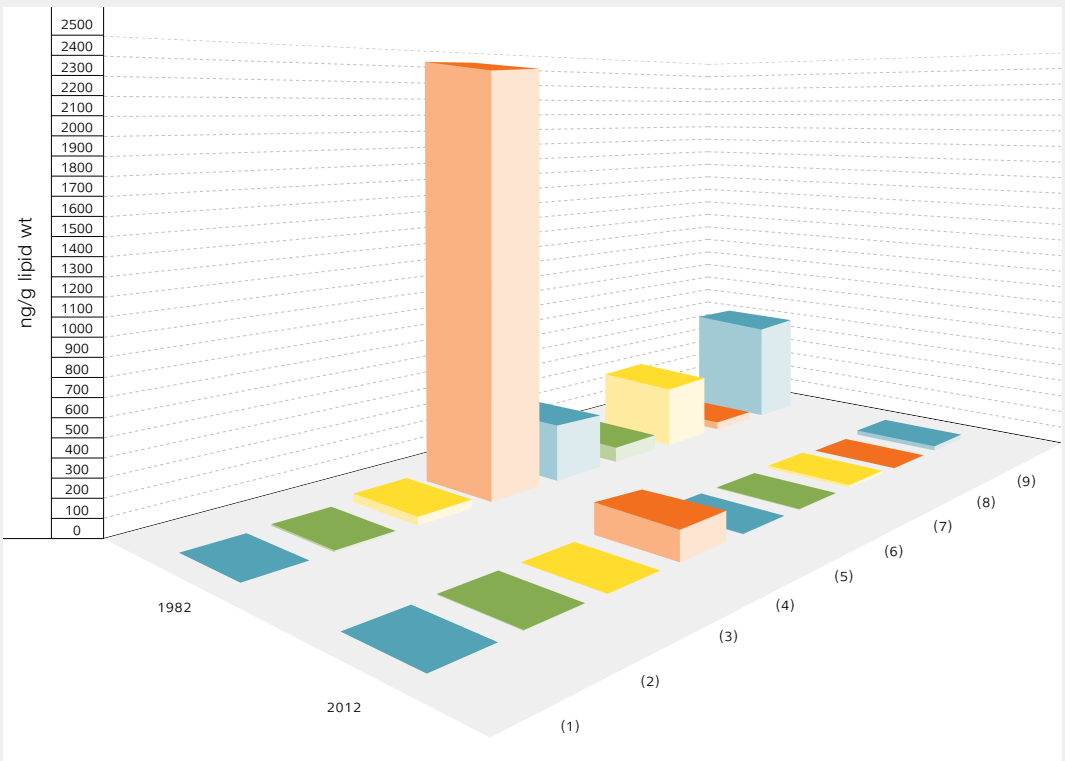
The study was conducted by the Ministry of Health (MoH) in collaboration with the Ministry of Environmental Protection (MoEP) as part of the World Health Organization (WHO) coordinated survey on POPs in breast milk. In 2012 breast milk was collected from 52 women who delivered at three hospitals in the central region of Israel and one pooled sample was analyzed for over 50 POPs including polybrominated dioxins and furans and polybrominated diphenyl ethers (flame retardants).

The major findings were:

- Levels of indicator compounds (chlordanes, DDT compounds, hexachlorocyclohexanes, and PCBs) were comparable to and mostly lower than those reported in European countries.
- Concentrations of indicator compounds declined significantly since 1982, with the decrease likely attributable to restrictions on agricultural, industrial, and other uses of many POPs in Israel.

Persistent Organic Pollutants in Breast Milk in Israel, 1982 and 2012*

→
Figure 1
Source: Israeli Ministry of Health (8,9,10,11)



* Sum indicators for PCBs in 1982 assumed comparable to those in 2012.

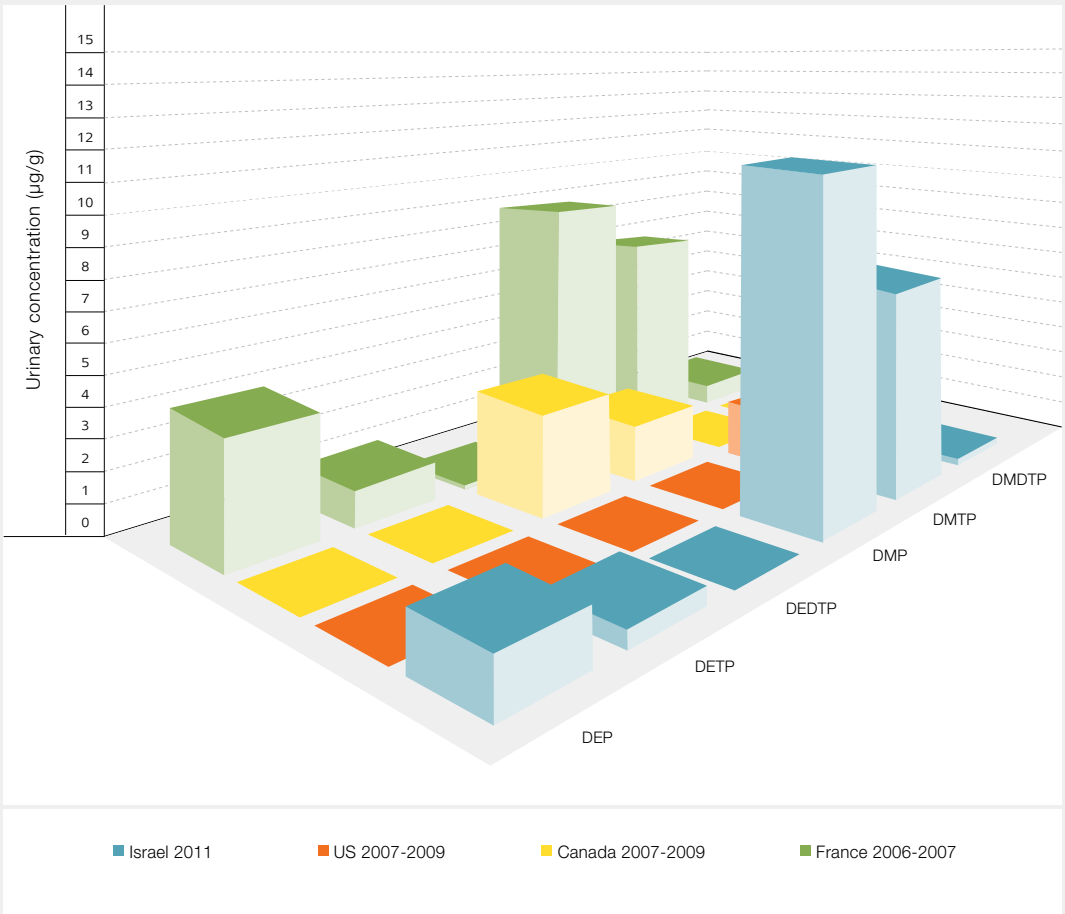
Non-Persistent Environmental Contaminants in Urine

In a study conducted by the MoH in 2011, spot urine samples and detailed questionnaire data were collected from 250 adults recruited from five different geographic regions in Israel. Urine samples were analyzed for bisphenol A (BPA), phthalate metabolites, cotinine, polycyclic aromatic hydrocarbons, organophosphate metabolites, and phytoestrogens.

The major findings were:

- The study population was widely exposed to all contaminants measured in the study.
- Exposures to organophosphates and environmental tobacco smoke (ETS) were relatively high among the study participants compared to other international populations.
- In non-smokers, ETS exposure was highest in males, younger, and less educated participants.
- BPA levels among Jews were high compared to Arabs and Druze.
- Fruit consumption was a source of exposure to organophosphate pesticides.

Median Creatinine Adjusted Organophosphate Urinary Metabolite Concentrations (µg/g) in the Israeli Study Population and Populations in the United States, Canada, and France



←
Figure 2
Source: Israeli Ministry of Health (3)

Research on Human Biomonitoring in Israel

There are numerous epidemiological studies currently underway in Israel employing biomonitoring for exposure assessment, including studies on the health effects of organophosphate pesticides, phthalates, heavy metals, ETS, brominated flame retardants, and BPA.

- Researchers at the MoH and Ben-Gurion University are using biomarkers of heavy metals exposure, and examining exposure to environmental factors such as industry and home environment, to study risk of congenital anomalies in infants born to Arab-Bedouin women in southern Israel.
- Researchers at the MoH and at Ben-Gurion University are examining the effects of air pollution on cell proliferation as an indicator of subclinical pathology in fetuses of 210 Arab-Bedouin women in southern Israel.
- Researchers at the Hebrew University Center of Excellence in Agriculture and Environmental Health are using biomarkers to study the effects of organophosphate pesticides on male reproductive health and birth outcomes, as well as the effects of BPA, phthalates, and genistein on birth outcomes.
- Researchers at Hebrew University–Hadassah, Assaf Harofeh Medical Center, and Mount Sinai Hospital, NY are using biomarkers to study exposures to phthalates and ETS in children.
- Researchers at Hebrew University–Hadassah are using biomarkers (POPs in serum) to explore risk factors for non-Hodgkins lymphoma in Palestinian and Israeli adults.
- Researchers at Assaf Harofeh Medical Center, Tel Aviv Sourasky Medical Center, and Columbia University, NY are using biomarkers to measure exposures to brominated flame retardants (polybrominated diethyl ethers and hexabromocyclododecane) and phthalates in mother–infant pairs and the effects on birth outcomes and thyroid function.
- Researchers at Tel Aviv Sourasky Medical Center are measuring exposure to nano-particles in Exhaled Breath Condensate, and effects in asthmatic vs. non-asthmatic children.
- Researchers at Tel Aviv Sourasky Medical Center are using biomarkers to explore differences in exposure to endocrine disrupting chemicals (EDCs) in residents of an organic food/vegan community in northern Israel (Amirim).
- Researchers at the Hebrew University Center of Excellence in Agriculture and Environmental Health are evaluating the presence of dialkyl phosphates in edible crops and estimating exposure to organophosphate pesticides considering exposure to both parent compounds and their metabolites.

Progress and Challenges

- Data collected in human biomonitoring studies conducted by the MoH from 2010 to 2013 have implications for public health policy. Data on decreasing levels of POPs in breast milk were instrumental in showing that restrictions on use of agricultural and industrial chemicals in Israel were useful in reducing exposures in the general population. Data on relatively high

levels of exposure to organophosphates were instrumental in directing policy with regard to reduction of agricultural use of organophosphates, while data on exposure to ETS were instrumental in support of implementation of smoke-free legislation in Israel.

- There has been significant progress recently in the field of biomonitoring in Israel, and much biomonitoring data will be generated by the studies currently underway. In addition, the MoH has plans to continue biomonitoring as part of the 2014–2015 National Nutrition and Health Survey (urinary cotinine and urinary organophosphate metabolites in 300 children and adults). However, to date, there is no long-term plan for biomonitoring in Israel, including target populations, target chemicals, and planned uses of biomonitoring data for public health/environmental health policy.
- Due to the absence of laboratories in Israel with proven capacity to measure low-level exposure to environmental contaminants in biological samples, human biomonitoring studies in Israel have increasingly relied on collaboration with foreign laboratories. This substantially increases the cost of human biomonitoring studies in Israel.
- Regional biomonitoring projects, such as the DEMOCOPHES study in 17 European countries, have focused on developing a harmonized approach to biomonitoring. Joining such a regional or international harmonization effort would advance the field of biomonitoring in Israel considerably and would allow for better data comparability.

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Chapter 9

Asbestos

Asbestos is a fibrous material that is a human carcinogen (Group 1). Exposure to asbestos affects immune function and causes various respiratory diseases, such as lung cancer, pleural disorders and mesothelioma. In children, asbestos exposure has been linked to self-reported respiratory symptoms such as cough. In 2009, the International Agency for Research on Cancer (IARC) added cancer of the larynx and ovaries to the list of diseases linked to exposure to asbestos. In recent years, IARC has compiled reports on mesothelioma in individuals not occupationally exposed to asbestos, including patients whose families do not include asbestos workers. Co-exposure to asbestos and smoking produces a synergetic effect in the risk of lung cancer.

Current Regulations

Regulations requiring periodic medical examinations for individuals working with asbestos dust, talc, and silicon dioxide were instituted in 1964. The 1984 Occupational Hygiene and Health of Public and Workers Exposed to Hazardous Dust Regulations included specification of prohibited and permitted substances, as well as obligations regarding occupational and environmental monitoring.

The Prevention of Asbestos Hazards and Harmful Dust Law was enacted in 2011. As in other developed countries, the law prohibits new use of asbestos and thus limits environmental exposure to asbestos. The law requires the gradual phase out of friable asbestos from public buildings and industry by 2021. The law also requires proper maintenance of asbestos cement in

public buildings and stipulates the need for work permits for asbestos work and special licenses for asbestos workers under the auspices of the Ministry of Environmental Protection (MoEP).

Ministers at the 2010 Fifth Ministerial Conference on Environment and Health addressed the health problems linked to asbestos exposure. The European branch of the World Health Organization (WHO) committed to developing national programs for elimination of asbestos-related diseases tailored to European countries by 2015. Israel is collaborating with countries that are partners in this program.

Exposure to Asbestos in Israel

Exposure to asbestos occurs mainly in asbestos removal, demolition, maintenance work, and the handling of asbestos waste. Asbestos cement was widely used in Israel; the Eitanit (formerly Isasbest) asbestos factory in Nahariya was in operation from 1952–1997. It is estimated that about 100 million square meters of asbestos cement was used in Israel. An asbestos hazard persists in the western Galilee near the Eitanit factory because industrial waste accumulated at the factory was dumped or dispersed throughout the western Galilee to cover land or pave roads. In March 2011, the MoEP began to implement a five-year project budgeted at NIS 300 million to identify, remove, and dispose of asbestos waste in the western Galilee. Half of this sum was allocated by the MoEP and half was paid by the Eitanit asbestos factory. By the end of 2013, some 159 public and private sites were cleaned, and more than 55,000 cubic meters of asbestos waste were removed.

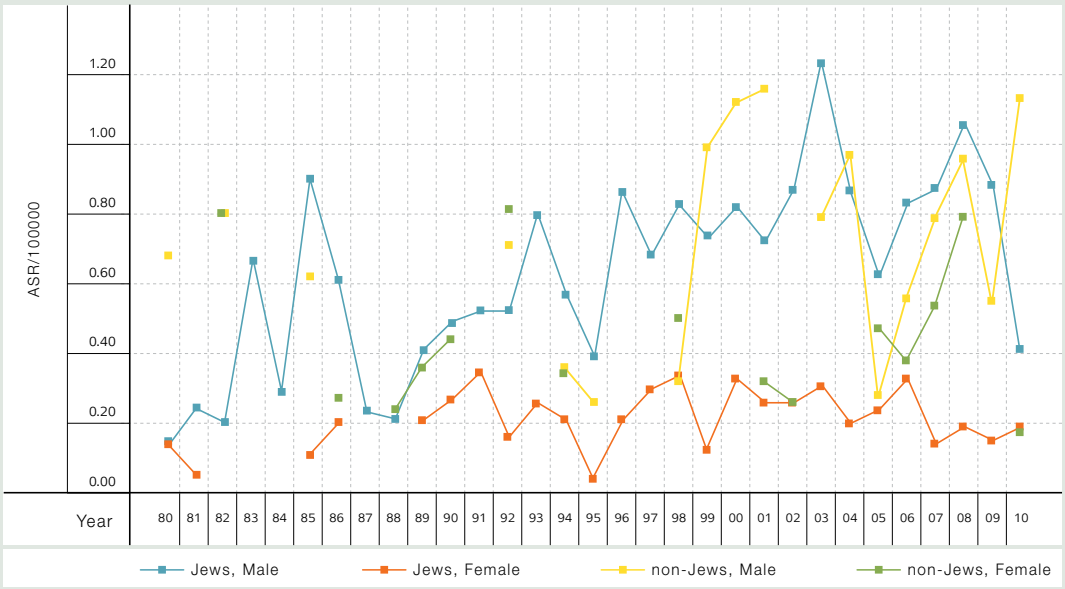
Data on Health Effects of Asbestos in Israel

In Israel, there are three asbestos-related disease registries:

1. A registry of work-related diseases is under the purview of the Ministry of Health (MoH), in collaboration with the Ministry of Economy (MoE). This database includes information on each case of disease linked to asbestos, with details on the injured person's occupation, previous places of employment, demographic information, and details about the illness. The law requires all physicians, both from Health Maintenance Organizations and private medical services, to report work-related diseases via a structured information form. So far, reports have come primarily from occupational physicians and pulmonologists from a number of hospital-based lung institutes. The registry does not cover family members of asbestos workers.
2. The MoH database on causes for hospitalization allows for reasons for hospitalization relevant to asbestos exposure to be identified. The database includes demographics on the hospitalized patients. There is also information on repeated hospitalizations for the same reason.
3. The National Cancer Registry of the MoH contains information on types of cancer relevant to asbestos exposure, with demographic data that includes a history of residential addresses. This database does not contain data on places of employment.

Based on data from the National Cancer Registry, there has been an increase in the reported incidence of mesothelioma in the general population in Israel, with higher rates in men during the years 1980–2007 (Figure 1). Asbestos is one of the known causes of lung cancer, which was the leading cause of death in Israel in 2011.

Incidence of Mesothelioma in Israel, 1980-2010



←
Figure 1
Source: Israeli Ministry of Health (5)

Research on Health Effects of Asbestos in Israel

Between 2010-2014, one study was published on asbestos-related disease in Israel. This 2012 study summarizes the results of medical monitoring over a 15-year period after cessation of exposure to asbestos in a cohort of Israeli power plant workers.

Progress and Challenges

- There are limited data in Israel on the health effects of environmental exposure to asbestos.
- The MoE is preparing regulation pertinent to occupational exposure to asbestos with the aim of lowering the maximum permitted threshold for working with asbestos to 0.1 fiber/cm^3.
- The MoH is working on maintenance and expansion of the registry of occupational diseases with an emphasis on information pertaining to specific types of occupational disease and specific workplaces.
- The MoEP is focusing on implementing the 2011 Asbestos Law, primarily with regard to mapping and removing all friable asbestos by 2021 and maintaining public buildings that contain asbestos cement.

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Chapter 10

Non-Ionizing Radiation

Exposure to non-ionizing radiation is ubiquitous. Sources include visible light, lasers, infrared radiation, radio frequency (RF) radiation from wireless communication facilities: cellphones, cellular networks, television and radio broadcast facilities, as well as radiation of extremely low frequency (ELF) from electrical facilities. Exposure to sources of non-ionizing radiation has been associated with negative health effects. Exposure to radio waves, for example can cause localized tissue heating. Non-thermal effects have yet to be proven, but they are the subject of much ongoing research. Epidemiological research indicates that exposure to magnetic fields around electrical facilities at levels of 3–4 milligauss increases risk of leukemia in children.

Current Regulations and Policy

The Non-Ionizing Radiation Law (2006) entered into effect in January 2007 with the goal of protecting the public and the environment from the effects of exposure to non-ionizing radiation, in accordance with the precautionary principle. Standards addressing non-ionizing radiation were approved in 2009.

The law and the standards which pertain to exposure to non-ionizing radiation from artificial sources regulate both licensing and the level of expertise required for individuals working with sources of non-ionizing radiation. In addition, the regulations mandate monitoring levels of non-ionizing radiation and publicizing the information.

Radio Frequency Radiation

The law requires that the Ministry of Environmental Protection (MoEP) define maximum levels of exposure permitted for RF radiation. The levels of permitted exposure are based on World Health Organization (WHO) recommendations regarding the health threshold for non-ionizing radiation (a value below which there is no known negative health impact from thermal effects). The health threshold refers to acute (short-term) exposure only. The environmental threshold, which refers to continuous long-term exposure, takes into account risks other than those defined in the health threshold. In areas such as parks, roofs, and courtyards where exposure is not continuous, permits are not granted for facilities that expose the population to non-ionizing radiation of more than 30% of the health threshold, whereas in areas where people are continuously present and for long periods of time – such as educational institutions, homes, and hospitals – the maximum exposure permitted is only 10% of the health threshold.

Magnetic Fields (Power Lines and Electrical Appliances)

The Non-Ionizing Radiation Law does not define a threshold for exposure to magnetic field radiation. A threshold value of 1,000 milligauss for acute short-term exposure (momentary exposure) was recommended by an expert committee on public exposure to magnetic field radiation from the electrical grid. While there is no standard for long-term exposure to magnetic fields, the MoEP and the Ministry of Health (MoH) jointly recommend a threshold of two milligauss on an average annual basis when planning an electrical facility or four milligauss on a daily average. At this stage, existing electrical facilities are being targeted for action, with highest priority assigned to facilities that generate an average exposure of over four milligauss. In addition, new building regulations limit electromagnetic fields (EMF) generated by the power grid to four milligauss. The MoEP published recommendations for planners and the Israel Electric Corporation (IEC) pertaining to the operation of electric facilities, risk assessment and calculation of levels of exposure to EMF. The MoEP has defined minimum distances between electrical facilities and buildings such as homes, educational institutions, hospitals, etc. (Table 1). The IEC website reports results of measurements performed near electrical facilities.

Ministry of Environmental Protection Recommendations on Distance between Electrical Facilities and Buildings

→ Table 1

Type of line	Short-term exposure	Long-term exposure
Low voltage line	2 meters from nearest phase conductor	3 meters from nearest phase conductor
Medium voltage line (13, 22, 33 kilowatts)	3 meters from nearest phase conductor	5 meters from nearest phase conductor
High voltage line (161 kilowatts)	20 meters from the path of the power line	30 meters from the path of the power line
Extra-high voltage line (400 kilowatts)	35 meters from the path of the power line	50 meters from the path of the power line
Distribution transformer	3 meters from each part of the transformer and extending wires	5 meters from each part of the transformer and extending wires

Public and home use of electrical and electronic devices is regulated within the framework of the Non-Ionizing Radiation Law. In recent years, researchers and policy makers have raised concerns about possible health effects from exposure to EMF in the range of the power grid at frequencies of 50 hertz. In 2001, the International Agency for Research on Cancer (IARC) classified extremely low-frequency magnetic fields as possibly carcinogenic to humans. The WHO recommends a maximum permissible exposure of 1,000 milligauss for acute short-term exposure and encourages application of the precautionary principle vis-à-vis continuous and long-term exposure. The MoEP publishes tables listing the levels of exposure from home electrical devices.

Cellular Communication

Cellular communication requires both a base station (antenna) and a telephone device. Categories of base stations are defined under the Communications Law from 1982 and the National Outline Plan 36 on Small and Miniature Broadcast Facilities from 2002. Cellular companies are responsible for choosing the location of base stations, a function subject to permit and oversight by the MoEP. In Israel, cellular broadcasts are limited to the range of non-ionizing radiation: 700–2,500 megahertz. As a rule, the taller the antenna and the more powerful its transmission, the wider the geographic range that it covers. The MoEP website includes an interactive map which shows the location of both existing and planned antennas.

Manufacturers are required to measure Specific Absorption Rate (SAR) in accordance with international (US and European) guidelines and manufacturing standards for cellphone devices. The SAR index describes the amount of energy absorbed by a unit of mass of biological material under conditions of maximum transmission capacity. According to the guidelines, the devices cannot cause a local increase in body temperature of more than one degree Celsius (°C).

Although the MoH lacks authority under the Non-Ionizing Radiation Law, the Ministry publishes recommendations on reducing public exposure. The MoH recommends sensible use of cellular and wireless technology, including: considering alternatives like landline telephones, use of a speaker while talking on a cellphone, and refraining from installing the base of wireless phones in a bedroom, work room, or children's room. In addition, according to a 2002 directive from the MoH's Medical Administration, cellphones should not be used within 30–50 centimeters of medical equipment.

In general, the MoH's recommendations are based on guidelines from international organizations:

- Use a speaker or hands-free phone accessory or (non-wireless) personal earphone in order to distance the telephone from the body, reduce the amount and duration of calls, with the goal of reducing exposure.
- In areas with few antennas where reception is weak, the level of radiation from the device is high and the number and duration of calls should be reduced.
- Precautions should be strictly enforced with regard to children, who are more sensitive to developing cancer.

- When driving, a hands-free device should be used for calls (Traffic Regulation No. 28B). It is recommended to install an antenna outside the vehicle and to use a line connection between the telephone and the speaker as opposed to using Bluetooth.
- The MoH recommends not using cellphones in closed places (for example, elevators, buses, trains) due to amplified radiation in such places.

In March 2012, a bill was proposed requiring all cellphones sold in Israel to bear a health-hazard warning label. The proposed bill also requires that all mobile phone advertisements bear a similar warning and bans all advertising targeting minors. The bill has yet to be approved by the Knesset.

Data on Exposure to Non-Ionizing Radiation in Israel

In September 2010, the MoEP developed an automatic system to conduct ongoing monitoring of radiation from antennas. An initial report on data from the monitoring system was published in 2012.

In 2003, in an effort to determine levels of radiation in public places, levels of non-ionizing radiation were measured in 25 schools nation-wide. In addition, electrical facilities located within schools were tested, including electrical distribution networks (electrical panel boards, electrical cabinets, distribution lines), fluorescent lighting, wireless internet networks, and electric motors. The results revealed that exposure to non-ionizing radiation in schools is very low, with the exception of classrooms and staffrooms close to electric panel boards. Based on these findings, the MoEP recommends that students remain at a distance of at least 1.5 meters from electrical cabinets and that use of wireless communication networks in schools be reduced.

Despite the fact that hybrid vehicles are liable to emit non-ionizing radiation, the MoEP has no authority under the Non-Ionizing Radiation Law to license or monitor radiation from hybrid vehicles. In 2010, an expert committee convened to evaluate EMF generated by hybrid vehicles and recommended measuring radiation levels in hybrid cars. The MoEP conducted comprehensive tests for non-ionizing radiation in various hybrid vehicles and publicized the results. Based on the findings, the MoEP concluded that hybrid cars are indeed recommended for public use – due to their low levels of radiation as well as their offering a major reduction in transport-related air pollution.

Research on Health Effects of Non-Ionizing Radiation in Israel

In 2006 a national center to study the public health impact of non-ionizing radiation was established. Pursuant to government decision, a scientific steering committee was formed with representatives from the Ministries of Defense, Communications, Environmental Protection,

Health, and National Infrastructures, Energy and Water Resources. In 2012, a tender was published to establish the Center, with three years of funding from the Ministry of Science and the MoEP. The Center (TNUDA), which opened in 2013 in collaboration with the Cancer and Radiation Epidemiology Unit at the Gertner Institute for Epidemiology and Health Policy Research, provides responses to queries including those from various government ministries. At a later stage it will conduct basic, epidemiological research and risk-assessment.

During the past five years (2010–2014), a small number of studies have been conducted in Israel to test the health impacts of non-ionizing radiation, in particular the effect of EMF radiation on nerve cells and on cellular stress.

Israel participated in the INTERPHONE research project, following a 1996 recommendation by IARC to conduct a comprehensive epidemiological study to examine the association between the use of cellphones and cancer. Findings in Israel clearly indicated a link between cellphone use for more than 10 years and the development of tumors in the salivary glands, particularly among people who held the telephone on the same side where the tumor developed and individuals in the highest category of exposure (heavy use in rural areas).

Israel is currently a partner in two additional international studies: (1) MOBI-Kids, a multi-center study involving experts from 16 countries who are examining potential associations between use of communication devices and other environmental factors and risk of brain tumors, and (2) the GERoNiMO (Generalised EMF Research using Novel Methods) project, which uses an integrated approach and expertise from 13 countries to further the state of knowledge on EMF and health. Both studies are funded by the European Union and managed (in Israel) at the Gertner Institute's Cancer and Radiation Epidemiology Unit.

Progress and Challenges

- Establishment of a National Center for Information on the Health Effects of Non-Ioninzing Radiation, and the launch of an interactive website which provides information on planned and existing cellular antennas, has significantly improved transparency regarding non-ionizing radiation and potential health effects.
- There is a lack of public awareness regarding proper use of products that emit non-ionizing radiation – including cellphones, microwaves, adjustable beds, and laptop computers.
- There are significant challenges in regularly monitoring devices in public spaces (such as transformers and power lines) and conducting measurements to enable accurate exposure assessment.
- Standards regarding cellphone use are based solely on thermal impacts (localized heating of tissue). As new findings regarding additional health effects emerge, Israel will need to re-evaluate non-ionizing radiation standards in accordance with international regulatory developments.

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Chapter 11

Climate Change

Extreme climate change is likely to have acute effects on human health, including both physical and psychological damage due to extreme conditions like drought, floods, fires, and heat/cold waves. Moderate climate change is also expected to impact patterns of morbidity and mortality. For example, climate change may lead to changes in the patterns of chronic illnesses such as cardiovascular disease, respiratory disease, and even cancer. Increases in ground-level ozone (O_3), caused by high temperatures, can increase risk for asthma in children. Even moderate climate change is likely to alter the seasonality of infectious diseases (viral, bacterial, and parasitic), particularly those transmitted among human beings (for example: diarrhea, mumps, measles, and rubella). Climate change is also expected to impact incidence of diseases transmitted by vectors such as insects (for example, West Nile virus, malaria and cutaneous leishmaniasis) and rodents (for example, plague, typhus, and leptospirosis), as well as pesticide use for vector control. The prevalence of illnesses related to poor sanitation – such as foodborne disease – is also likely to be affected by climate change.

Current Regulations

Contribution to the Global Effort against Global Warming

Emission of greenhouse gases and industrial and transportation pollutants are the main causes of global warming and climate change. Since Israel was not a party to the first annex of the UN Framework Convention on Climate Change, it did not commit to reducing greenhouse gas

emissions between 2008 and 2012. However, pursuant to a government decision, a national plan for energy efficiency entered into effect in 2010. The plan set an efficiency target of 20% for 2020 (reduction of energy costs and more efficient use of energy). The Clean Air Law, which entered into effect in 2011, along with "green" taxation for vehicles (which provides higher tax benefits for vehicles that pollute less) are also expected to contribute to a reduction not only in air pollution, but to greenhouse gas emissions as well.

Preparation and Adaptation for Climate Change

In June 2009, a committee of directors-general was formed that was authorized to formulate recommendations for a national action plan to prepare and adapt for climate change. One of the components of the plan was to draft guidelines for relevant government ministries so as to equip them with tools required for minimizing damage resulting from changing climatic conditions. The Israeli Climate Change Information Center (ICCIC) was established in March 2011 by the Ministry of Environmental Protection (MoEP) at the University of Haifa. The ICCIC published three reports in 2012–2013.

The Israel Defense Force (IDF) Home Front Command is responsible for taking care of the general population in the event of natural disasters, including extreme climate events (for example earthquakes and flooding). The Emergency Department at the Ministry of Health (MoH) provides organizational and logistical infrastructure related to the healthcare system during emergency situations, including natural disasters. Today, there is no entity in Israel responsible for climate events that are not defined as extreme events. There is, for example, no specific legislation focusing on preparation for climate change associated with global warming.

Data on Climate Change in Israel and the Health Effects of Climate Change

Since the 1960s, higher temperatures have been recorded in the Middle East, with an increase in the frequency, intensity, and duration of heat waves. At the same time, there has been a decline in the general amount of rainfall, as well as a change in the pattern of rain distribution during the rainy season. In recent decades there has been a steep rise in the number and scope of forest fires in the Middle East. During extreme climate events in January and December 2013 new records were set for rainfall and water flow. The data indicate that gradual and extreme climate events are already occurring in Israel. While the connection between acute climate events and public health is clear, the link between gradual change in climatic conditions and human health is more difficult to prove.

Since the climate in Israel is relatively susceptible to severe heat waves, the effects of heat waves on mortality in Israel need to be examined. A study published in 2014, based on data collected between 2000 and 2005 reported an increase of about 3.7% in mortality in Tel Aviv from cardiovascular and respiratory diseases for every increase of one unit in the thermal discomfort index (a combination of temperature and relative humidity) above the defined threshold value.

This study found that even a single day in which the heat burden exceeded this threshold is sufficient to cause an increase in mortality rate. This study did not examine implications of climate change on morbidity rates that did not culminate in death. Another study conducted in Israel reports a 1.47% increase in the number of visits to hospital emergency departments with each increase of 1 °C in ambient temperature during heat waves.

Research conducted several years ago in Israel found that an increase in temperature is a positive predictive factor for size of the mosquito population. The rise in the number of mosquitoes, a vector for West Nile fever and other diseases, was found to be a risk factor for disease transmission. Similarly, another study conducted in Israel found a connection between the rise in water temperature in fishponds generated by heat waves and an increase in morbidity caused by Vibrio vulnificus bacteria.

A study conducted in collaboration with the MoH and published in 2013 described an association between the number of reported cases of West Nile fever, which is transmitted by mosquitoes, and environmental temperature. This study, examining the impact of various climate factors on the outbreak of West Nile fever in Europe in 2010, found that morbidity in northern Europe increased about two to four weeks after the rise in temperature. In Israel and countries located in southern Europe there is a shorter time-lag between increase in temperature and onset of illness. These data indicate that while in northern Europe a rise in temperature is a predictive indicator for taking preventive action, in Israel the time-lag is liable to be either too short or too late for effective warning.

There has been an increase in morbidity from Campylobacter bacteria in recent years in Israel. Campylobacter is pathogenic for human beings, causing a range of malignant symptoms in the digestive system. A study examining the impact of external temperature on reported morbidity in Israel between the years 1999–2010 found that high temperatures throughout the year are linked to greater morbidity from Campylobacter. With regard to the general population, an increase in temperature of 1 °C under the threshold temperature of 25 °C raises the rate of morbidity from Campylobacter by 3.8%, while an increase of 1 °C above this threshold temperature raises the rate of morbidity from Campylobacter by 15.4%. The study also found that different age groups have different thermal sensitivity thresholds to morbidity from Campylobacter, and concluded that this finding is relevant to health impacts of global warming.

The MoH collects data on the incidence of morbidity from various factors, including morbidity from malaria, West Nile fever and cutaneous leishmaniasis, in weekly epidemiological reports available on the Ministry's website. These reports provide data on morbidity based on continuous monitoring of the population in Israel. These data are likely to indicate trends in the incidence of disease following gradual or extreme change in climate conditions.

In 2014, researchers from the MoH reported that after decades of small, intermittent outbreaks, nearly 1,400 cases of West Nile fever were reported in Israel between 2000 and 2012. Marked increases in the reported human cases coincided with the identification of new viral genotypes in the mosquito population (Figure 1).

West Nile Fever in Israel, 2000-2012

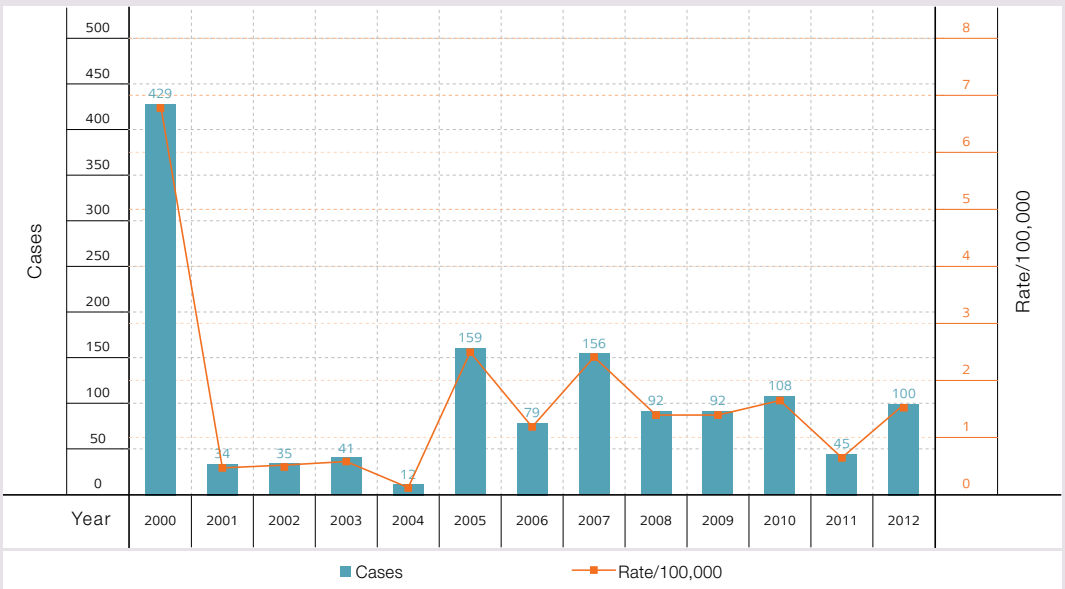


Figure 1
Source: Israeli Ministry of Health (2)

Research on Climate Change and Health Effects in Israel

- Researchers from the University of Haifa, Ben-Gurion University, Tel Aviv University and Bar-Ilan University found that a rise in ambient temperature increased the risk of heart defects among infants born in the Tel Aviv area during the years 2000–2006.
- A joint study by researchers from Tel Aviv University, the Hebrew University of Jerusalem and Sheba Medical Center (Heller Institute) is currently assessing the impact of climate on traffic accidents in Israel.
- The MoH Public Health Laboratories and Tel Aviv University's School of Public Health are jointly studying climatic fluctuations in Israel and their connection to the incidence of foodborne zoonotic diseases (salmonella and campylobacter) during the years 1995–2010. Within the framework of the study researchers will forecast possible effects of climate change on morbidity due to these food contaminants in the year 2030.
- The MoH publishes an annual report on the incidence of West Nile fever. Part of the long-term monitoring conducted in this epidemiological study includes information on the geographic distribution of suspected and verified cases of morbidity from the fever.
- The MoH is using the monitoring system of zoonotic diseases and the reporting system of the Israel Meteorological Service in order to study associations between change in temperature as an index of climate change and the incidence of cutaneous leishmaniasis. Thus far, the study focused on three regions in Israel that are considered to have high potential for contagion and found that an increase in the number of new cases occurs about 12 weeks (on average) after a high increase in temperature. The study will later focus on the impact of absolute humidity on the incidence of morbidity.

Progress and Challenges

- Based on reports submitted by the ICCIC, Israel has yet to develop a national plan for coping with climate change.
- Within the framework of the committee of directors-general, draft guidelines have been developed for the MoH to cope with climate change. These guidelines include recommendations for strengthening collaboration between the Meteorological Service and the MoH. Such collaboration would enable the health system to have more advance warning of extreme climate events and thus minimize the public health impact to the extent possible. Similarly, collaboration is needed to track patterns of diseases and morbidity that are likely to be affected by gradual climate change. The central challenge in monitoring the health effects of climate change in Israel is the lack of a nationwide up-to-date electronic database containing indices of exposure and health outcomes from hospitals and Health Maintenance Organizations.
- In recent years, there has been an increase in the number of cases of leishmaniasis in various places in Israel. The Leishmania parasite causes severe skin disease that is characterized by ulcers and infections. In 2012, in light of the rise in the number of cases, the government decided on a national plan for reducing Leishmania. The plan is funded by the MoEP and the MoH.

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Chapter 12

Environmental Health Indicators and Trends

Indicators are important tools for highlighting problems, identifying trends, and monitoring progress, all of which contribute to effective policy formulation. A complex system for collecting health and environmental data and indicators has been in place in Israel for many years. The Ministry of Environmental Protection (MoEP) published a comprehensive report on environmental indicators in 2010 and an additional report on well-being and sustainability indicators in 2013. The Ministry of Health (MoH) and the Central Bureau of Statistics (CBS) regularly publish data on health and health-promotion indicators, including life expectancy, infant mortality, diabetes prevalence, reported smoking rate, overweight and obesity, and percentage of adults engaging in regular physical activity. In 2012, Israel was chosen by the Organisation for Economic Co-operation and Development (OECD) to be the pioneer in consolidating a set of national indicators on well-being and sustainability.

While extensive health and environmental indicator data are regularly collected and published in Israel, and are being further developed within the framework of the OECD indicators project, environmental health indicators have not been developed in Israel. According to the World Health Organization (WHO), environmental health indicators are needed to:

- monitor trends in the state of the environment, in order to identify potential risks to health;
- monitor trends in health resulting from exposure to environmental risk factors, in order to guide policy;
- compare areas or countries in terms of their environmental health status, so as to target action where it is most needed or to help allocate resources;
- monitor and assess the effects of policies or other interventions on environmental health;
- help raise awareness about environmental health issues across different stake-holder groups; and
- help investigate potential links between environment and health (e.g. as part of epidemiological studies), as a basis for informing health interventions and policy.

Developing environmental health indicators and collecting relevant information require coordination and cooperation among stakeholders, such as: the MoH, the MoEP, the CBS, the Israel Center for Disease Control (ICDC), Health Maintenance Organizations, and NGOs.

Environmental health indicators have been developed by:

1. The WHO
2. The US Centers for National Environmental Public Health Tracking Network of the Disease Control and Prevention (CDC)
3. The European Union Environment and Health Information System (ENHIS).

The WHO framework includes environmental health indicators in 12 areas: socio-demographic context, air pollution, sanitation, hazardous/toxic substances, food safety, radiation, non-occupational health risks, occupational health risks, shelter, access to safe drinking water, vector-borne disease, and solid waste management. The CDC system includes indicators in 17 areas, while the ENHIS program includes 22 indicators. In 2010, the WHO proposed further development of the ENHIS guidelines so as to enable targeted evaluation of public health policy on reducing adverse health outcomes associated with priority environmental health factors.

Table 1 presents selected environmental health indicators chosen from the list of the WHO, CDC, and ENHIS indicators, with high relevance to environmental health in Israel. Data availability from the MoH, the MoEP, the ICDC, or other sources is indicated.

Selected Environmental Health Indicators and Data Availability in Israel

→ Table 1

Environmental Health Issue	Indicator	Source	Data Availability in Israel
Air pollution	Annual mortality rate due to acute respiratory infections in children under 5	WHO	Available from MoH
	Incidence of morbidity due to acute respiratory infections in children under 5	WHO	NA, Prevalence data available from annual ICDC influenza report
	Ozone days above regulatory standard	CDC	Available from MoEP
	$PM_{2.5}$ days above regulatory standard	CDC	Available from MoEP
	Hospitalizations for heart attack	CDC	Available from MoH
	Air toxics (benzene and formaldehyde average air concentration)	CDC	Available from MoEP
Asthma	Asthma prevalence among children	CDC and ENHIS	Available from ICDC surveys, most recently in 2008
	Emergency department visits for asthma	CDC	Available from MoH
	Hospitalizations for asthma	CDC	Available from MoH
Indoor Air	Insufficient ventilation in schools	ENHIS proposed	NA
	Exposures to selected indoor air pollutants in schools	ENHIS proposed	Partial data available from MoEP
	Radon levels in dwellings	ENHIS	Partial data available from MoEP
	Proportion of households using coal, wood, dung, kerosene as main source of heating and cooking	WHO	NA

← Table 1 (Part 2)

Environmental Health Issue	Indicator	Source	Data Availability in Israel
Drinking Water	Atrazine in drinking water	CDC	Available from MoH
Environmental Tobacco Smoke	Children's exposure to second hand tobacco smoke (13-15 yrs)	ENHIS	Data available from 2008 (MoH); Data available from Health Behaviors in School-Aged Children (HBSC) Israel; Data available on infant exposure, (MoH)
	Cotinine concentrations in blood serum	CDC	Data available on cotinine in urine, MoH
Vector-borne disease	Mortality rate due to vector-borne diseases	WHO	Available from MoH, Mandatory reporting from physicians and laboratories
Chemicals	Mortality rate due to poisoning	WHO	Partially available from Israel Poison Information Center
	Number of reported poisonings per year in children under 5 years of age	WHO	Partially available from Israel Poison Information Center
Food Safety	Proportion of potentially hazardous chemicals monitored in food	WHO	Available from MoH
	Exposure to chemical hazards in food (heavy metal intake in adults)	ENHIS	NA
Cancer	Incidence of selected cancers	CDC	Available from MoH, Israel National Cancer Registry
Childhood Cancers	Incidence of childhood leukemia	CDC and ENHIS	Available from Israel National Cancer Registry
Biomonitoring	Persistent Organic Pollutants (POPs) in human milk	ENHIS	Available from MoH
	Early life exposure to mercury (mercury in hair)	ENHIS proposed	NA
	Brominated flame retardants in human milk	ENHIS proposed	Available from MoH
	Levels of lead in children's blood	ENHIS, WHO and CDC	NA
Birth Defects	Prevalence of selected birth defects	CDC	Available from MoH, Israel National Perinatal Registry
Climate Change	Extreme heat days and events	CDC	Available from Israel Meteorological Service
	Heat stress emergency department visits	CDC	NA
	Heat stress hospitalizations	CDC	NA
	Heat stress mortality	CDC	NA
Developmental Disabilities	Children receiving intervention or services	CDC	Available from MoH
	Estimated prevalence of autism	CDC	Available from National Insurance Institute of Israel
Reproductive and Birth Outcomes	Fertility rate	CDC	Available from MoH
	Infant mortality	CDC	Available from MoH
	Low birthweight and prematurity among singleton births	CDC	Available from MoH
	Sex ratio	CDC	Available from MoH

The above table shows that data are available in Israel for numerous environmental health indicators developed by the CDC, WHO and the European Union. However, it is important to note that data are lacking for many environmental health indicators, including ventilation in schools, childhood exposure to lead and mercury, and data on heat stress related hospitalizations and mortality. In addition, there are environmental health indicators not included by the WHO, CDC or European Union that may have relevance for environmental health in Israel, for example, data on organophosphate exposure. Below is a summary of data for selected proposed additional environmental health indicators in Israel (Table 2).

Available Data for Additional Environmental Health Indicators in Israel

→ Table 2

Environmental Health Topic	Suggested Indicators	Data	Source
Ambient Air and Environmental Tobacco Smoke	Percentage of infants exposed to tobacco smoke, based on maternal self-report	31.5%	MABAT Survey, 2014
	Percentage of non-smokers with cotinine above level of quantification (LOQ), biomonitoring data	63%	MoH Survey, 2012
	Asthma adjusted prevalence rate (ages 21-65)	5.3 % men 6.3% women	ICDC, 2014
Chemicals in Water	Percentage of household tap samples with lead above 10 µg/L	2%	MoH Survey, 2011
Pesticides	Percentage of adult population with dimethyl – phosphate above LOQ	99%	MoH Biomonitoring Study, 2012

Data Sources - Health Trends in Israel

- The 1940 Public Health Ordinance requires mandatory reporting for selected diseases and health outcomes, including cancer, birth defects, and selected infectious diseases.
- Data on various diseases including asthma, diabetes, stroke, and cardiovascular disease are available in Israel from national surveys (the Knowledge Attitude and Practice Survey, the Israel National Health Interview Survey, Acute Coronary Syndrome Survey, National Acute Stroke Survey).
- The MoH has established databases on cause of death, emergency department visits, and hospitalizations.
- The Israel Center for Disease Control Diabetes Type 1 Registry includes information on diabetes in children, ages 0-17.
- Data are available on age of menarche from a population-based ongoing survey (in army recruits) from 1986 onwards, and on health problems among adolescents, based on mandatory examination of army candidates since 1967.
- There are national statistics on assisted reproductive technology in Israel beginning in 1990.

Selected Environmental Health Data and Trends

According to the WHO, an estimated 24% of the global disease burden and 23% of all deaths can be attributed to modifiable environmental factors, including diarrhea, lower respiratory infections, injuries and malaria. This chapter presents current data in Israel (and long-term trend data when available) on selected health endpoints associated with exposure to environmental contaminants (including radiation, endocrine disrupting chemicals (EDCs), lead, indoor pollution, ambient air pollution).

Cardiovascular Diseases

Cardiovascular diseases have been associated with exposure to air pollution, exposure to chemicals such as lead, and exposure to environmental tobacco smoke (ETS). According to WHO estimates, exposure to outdoor air pollution accounts for approximately 2% of the global cardiopulmonary disease burden. Cardiovascular disease is the second leading cause of death in Israel in men over 45 and women ages 45–74. In Israeli adults, between 2007 and 2010 10.2% of men were diagnosed with heart disease, compared to 7.1% of women. Rates of cardiovascular-related mortality decreased by 70% in Israel between 1980 and 2011.

Asthma

Asthma development and exacerbation can be triggered by a variety of indoor and outdoor environmental exposures, including dampness, ETS, and air pollution. In 2008, the prevalence of asthma in children ages 13–15 (based on self-report) was 7.2% (7.2% for Jewish children, 7.0% for Arab children). This rate is slightly higher than that reported in 1997 (7.0% overall) and 2003 (6.4% overall). In adults over age 21, 5.8% reported between 2007–2010 that they were diagnosed with asthma.

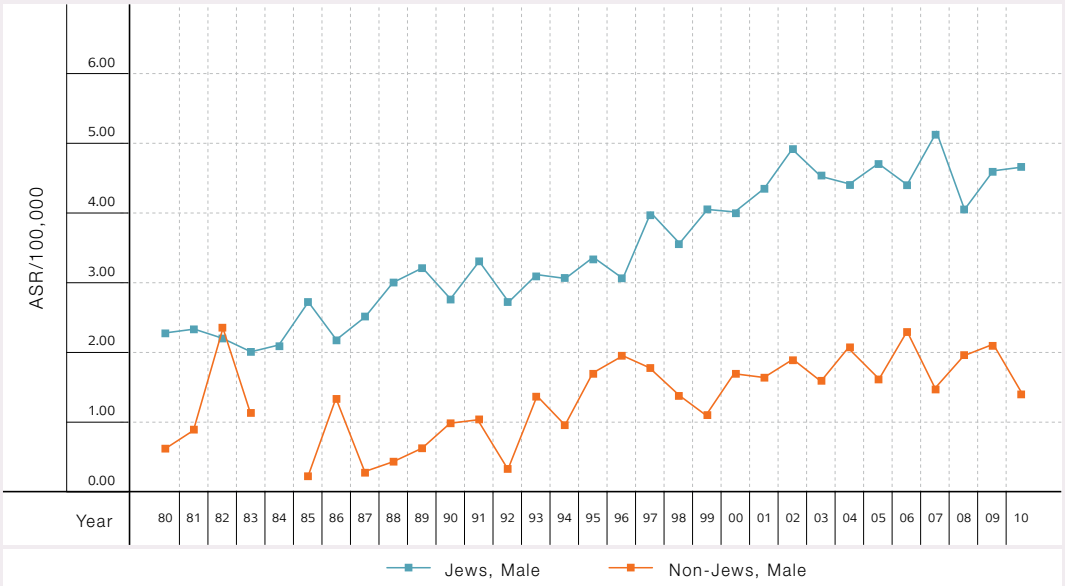
Cancer

Environmental and occupational risk factors have been linked to many types of cancer, primarily lung cancer, stomach cancer, leukemia, and melanoma. This report presents data on selected types of cancer: melanoma, which has been linked to excessive UV exposure; childhood leukemia, which has been linked to exposure to radiation and chemical agents; and testicular and breast cancer, which have been linked to exposure to EDCs. Based on data from the Israel National Cancer Registry of the MoH which includes an estimated 94% of solid tumors and an estimated 85% of non-solid tumors, rates of both invasive and in situ melanoma of the skin in Jews increased from 1980–2008 and decreased from 2008–2010. In non-Jews incidence rates have been unstable.

During 2000–2010 incidence rates of leukemia in children, ages 0–4 have been unstable (minor increase in both Jewish males and non-Jewish females and a decrease in both Jewish females and non-Jewish males). Incidence of in situ breast cancer increased both in Jewish and Arab women from 1990 to 2010 (the increase since 1996 can be explained by the National Mammography Program). Incidence of invasive breast cancer increased in Jewish women between the early 1990s and 1998 and then decreased steadily until 2010. In Arab women, invasive breast cancer rates more than

doubled between 1990 and 2010, possibly due to improved diagnosis and socioeconomic changes in the population during that time. Age-standardized testicular cancer rates in Israel increased from 2.28 (per 100,000) in 1980 to 4.68 in 2010 in Jews and from 0.60 to 1.39 in non-Jews (Figure 1).

Age-Adjusted Testicular Cancer Rates in Israel, 1980–2010



→ **Figure 1**
Source: Israeli Ministry of Health (10)

Reproductive Health Trends

Infertility can be caused by a range of factors including aging, genetic abnormalities, acute and chronic disease, behavioral factors, and exposure to environmental contaminants. Low-level exposure to EDCs and ETS, including in utero exposure to these contaminants has been associated with decreased fertility. In Israel, fertility rates were generally stable between 2000 and 2012. In Jews, fertility rates increased from 18.7 (per 1,000) to 21.1 in 2012. In Arabs, fertility rates decreased from 35.0 (per 1,000) to 24.8. The male/female ratio in live births is 1.06 and has remained stable between 2000 and 2012.

Data are not available on current infertility rates. The rate of IVF treatment cycles (per 1,000 women aged 15–49) has increased in Israel from 11.5 in 2000 to 20.1 in 2012. The percent of live births from IVF (out of total live births) has increased from 2.5% in 1997 to 3.0% in 2001, to 3.3% in 2005, to 4.1% in 2009–2010, and to 4.4% in 2012. Much of the increasing demand for IVF treatments in Israel is attributable to economic and social factors (including state funding of fertility treatment). Age of menarche, which has also been linked to exposure to EDCs, exhibits a clear downward trend from 13.4 in women born in 1970 to 12.8 in women born two decades later.

Obesity

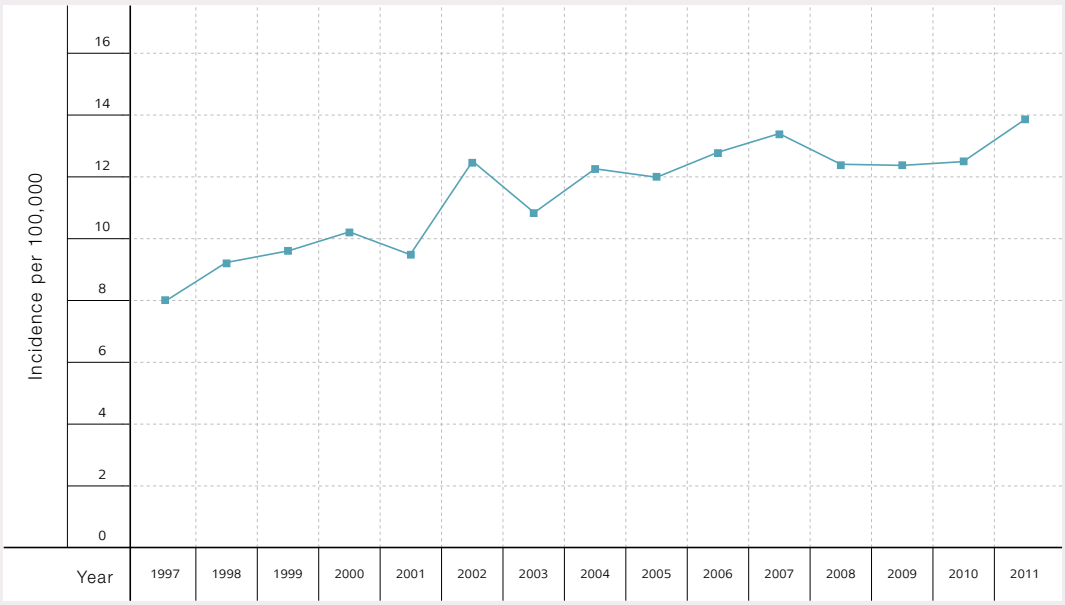
While the major risk factors for obesity are generally considered behavioral (high calorie fatty diets combined with a sedentary lifestyle), the risk of obesity is also related to genetic and environmental

factors. Recent toxicological and epidemiological studies indicate that in utero exposure to EDCs during development is associated with obesity and overweight later in life. Based on self-report in 2010–2012, 34.1% of adults 21 and older were overweight, while 15.7% were obese. In children, in 2013, 20.3% of first-grade students were overweight or obese, while 30.4% of seventh-grade students were overweight or obese. According to CBS data 50.1% of the population in Israel 15 and older is overweight or obese.

Diabetes

Exposure to EDCs has been linked to diabetes and prediabetic disturbances. For example, high dioxin levels have been associated with increased risk for diabetes or altered glucose metabolism. In Israel, there has been a monotonic increase in childhood Type 1 diabetes (ages 0–17), from 8.0 per 100,000 in 1997 to 13.9 per 100,000 in 2011 (Figure 2).

Incidence Rate (per 100,000) of Type 1 Diabetes in Children, 1997–2011



← Figure 2
Source: Israeli Ministry of Health (7)

In adults, incidence rates increased from 1997 to 2011 in both Jews and Arabs, with a 44% increase in incidence among Jews and a 55.6% increase among Arabs. Mortality rates from diabetes (including both Types 1 and 2) increased dramatically in Israel from the early 1980s to 1999 and since then have steadily decreased.

Congenital Anomalies

Selected congenital anomalies have been linked to in utero environmental or occupational exposures to chemicals, radioactivity, and ambient air pollution. The WHO estimates that 5% of all congenital anomalies are attributable to environmental factors. The rate of congenital heart malformations, which has been linked to ambient air pollution, has been stable from 2000–2010. The rate of hypospadias, a malformation of the male urogenital system which has been linked to exposure to EDCs, has increased slightly from 31.73 per 100,000 in 1974–1978 to 33.4 per 100,000 in 2004–2008.

Progress and Challenges

Although Israel does not yet have a formal environmental health indicators program, when comparing the data currently collected in Israel to other such programs, it is undoubtedly feasible to develop environmental health indicators for Israel. This, however, is not without its challenges. It will require coordination among the various entities responsible for different types of data collection, as well as mechanisms for validation and quality assurance. Making collected data on both environmental factors and health endpoints accessible to researchers, policy makers and the wider public, in a timely fashion, will be critical to the success of this endeavor.

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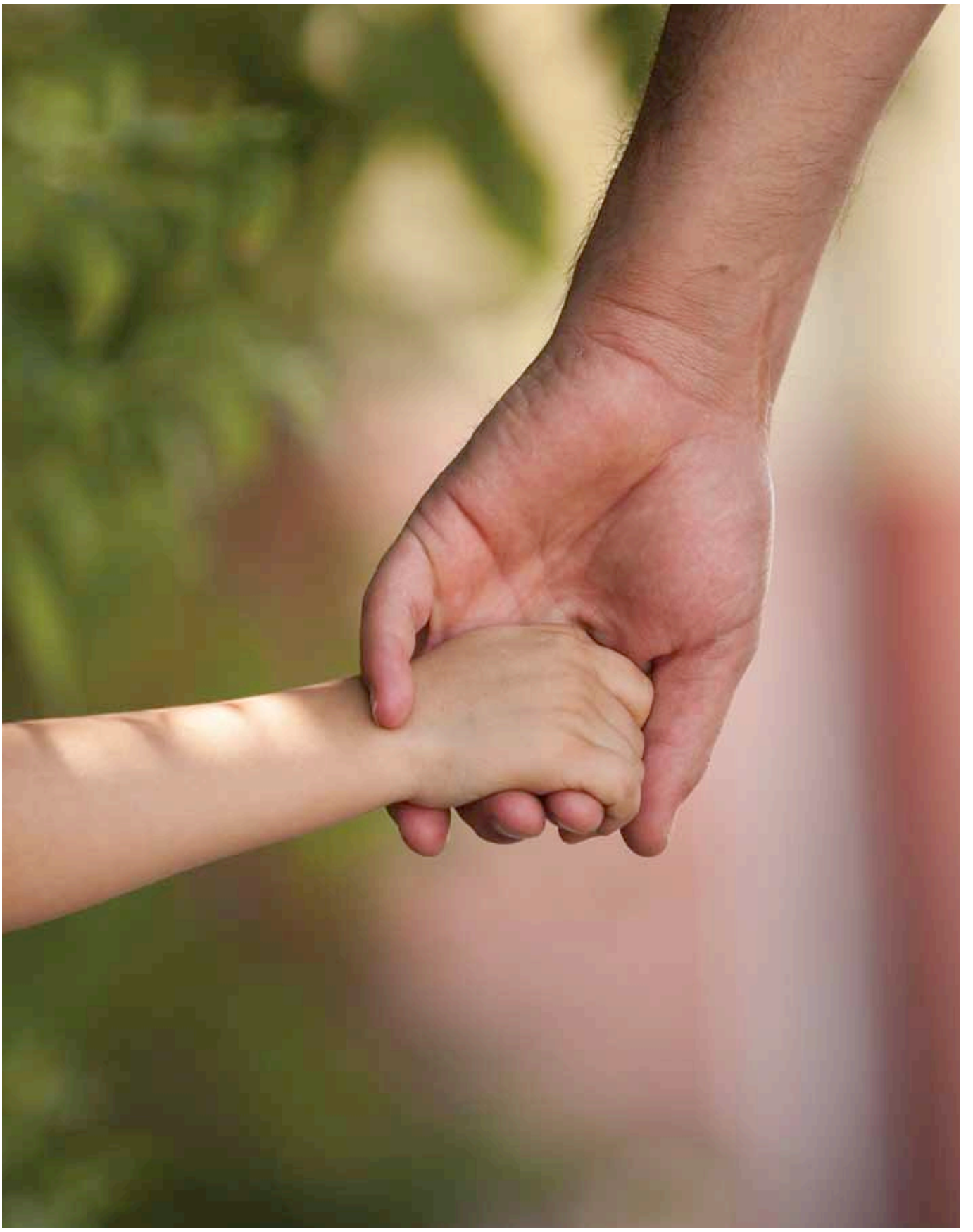
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Conclusions and Recommendations

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This report demonstrates many of the successes that have been achieved in legislation, regulation, and policy in the field of environmental health in Israel. The report also highlights the ongoing progress in this field, as many regulations related to environmental health in Israel are currently being updated (i.e. regulations related to pesticides in food and agricultural drift, regulations related to smoking in public places, legislation related to chemicals in personal care products).

In some cases, Israeli standards are better than those in other developed countries, but not in all. For example, ambient air quality standards often exceed those of the WHO or the United States. However, Israel has an impressive array of air monitoring stations in many, but not all, areas of the country. In contrast to ambient air, indoor air is largely unregulated, and depends on voluntary policies. Since even in Israel, most people spend the majority of their time indoors, more attention to indoor air standards would bring large benefits, for example, in the area of asthma prevention and control by reducing biological triggers (e.g., dust mites, cockroaches, mold), VOCs, particulates, and NOx.

Drinking water standards overall are appropriate and up-to-date. While setting the lead standard at 10μg/L is reasonable, given all of the information that there is no safe level of lead, the goal should be to reduce lead in drinking water to zero.

Israel has the dubious honor of having the highest relative use of pesticides of many developed countries. However, there are requirements for appropriate distances between pesticide application and homes and schools. Whether these are actually enforced is another issue. More attention

should be paid to the use of recycled wastewater and sludge in agriculture, addressing the issues not only of metals, but of organics such as pharmaceuticals, personal care products, PAHs, and POPs, which may be taken up by plants or spread by dust particles in the air.

There is little regulation of chemicals in consumer products. This has been evidenced by excessive use of flame retardants, often without proof of efficacy. There is also a tendency to move from one chemical of concern to another with less information on safety, as evidenced by voluntary removal of BPA from baby bottles and replacement with other largely untested additives.

Israel is a world leader in research on the health effects of non-ionizing radiation. If some of the studies turn out to be harbingers of things to come, we may have major health consequences from the nearly ubiquitous presence of wireless equipment. In addition, Israel would be well advised to increase its understandings and develop adaptation strategies for dealing with the health impacts of climate change which involve not only heat stress, but food safety, water safety, change in patterns of vector-borne disease, and increased air pollution.

Biomonitoring offers clear advantages in providing information about exposures of the general population to environmental contaminants. Widespread and statistically based biomonitoring programs can demonstrate changes, both good and bad, in the exposure of different segments of the Israeli population. This can demonstrate success in reducing exposure to certain contaminants, but can also provide opportunities for targeted action to reduce exposures. It is important to be forward thinking, and look not only for organophosphate pesticides, but for pyrethroids; not only for legacy POPs such as PCBs, but of current use compounds such as BFRs and PFCs, not only endogenous steroids but of a wide variety of high production volume endocrine disrupting compounds.

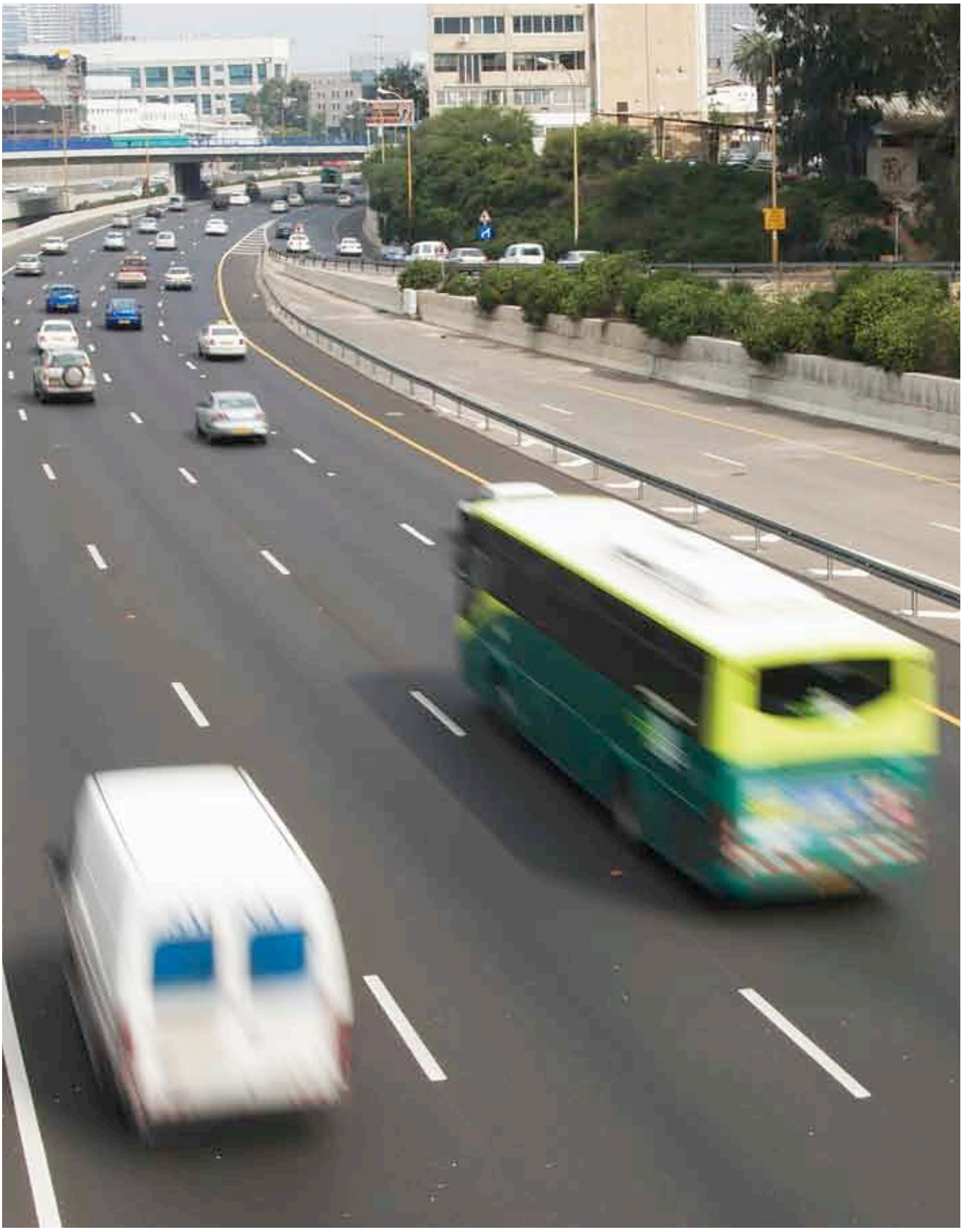
There is a clear need for increased interactions between the Ministry of Health and the Ministry of the Environmental Protection, as well as other Ministries dealing with transportation, agriculture, and commerce. For example, the location of homes and schools should be examined in relation to major roadways. There is growing evidence that proximity to high volume traffic is associated with adverse health effects, not only in adults, but in children from the time they are in the womb.

In Israel, as throughout the world, chronic non-communicable diseases are the largest contributors to both morbidity and mortality. More attention should be paid to the developmental origins of health and disease. For example, the exponential increase in overweight, obesity, and type 2 diabetes may have their origin in early life exposures to environmental chemicals, including tobacco smoke, pesticides, POPs, etc. The establishment of longitudinal birth cohorts will allow this to be studied and potentially avoided for future generations. The dramatic increase in autism spectrum disorders, ADHD, and cognitive effects has occurred too rapidly to be caused by changes in our genes, and are likely due to environmental agents of many types.

Specific recommendations include:

- Environmental health legislation and standards in Israel need to be enforced. A recurring theme in this report is that there are major challenges in enforcement of environmental health legislation and standards (e.g., smoking in public places, pesticides use in agricultural and non-agricultural settings, and contaminants in consumer products).
- Health impact assessments need to be conducted, as well as environmental impact assessments, when planning development. In a small and dense country such as Israel mindful planning can reduce environmental health problems.
- Databases on environmental and human monitoring should be created, maintained, and shared. Extensive databases available in HMOs on health endpoints relevant to environmental health should be made available for researchers in this field.
- The Israeli Ministry of Health should develop a strategic plan for biomonitoring, in collaboration with the Ministry of Environmental Protection and NGOs. Chemicals of concern include those in commerce, personal care products and pharmaceuticals. Israel needs qualified analytical laboratories for biomonitoring key analytes in biological media, such as cotinine and pesticides.
- Alternatives should be examined for safety before replacing chemicals of concern. Some of these chemicals of concern include BPA, phthalates, PFCs, and flame retardants. The current regulatory framework, in which the Minister of Economy has authority over standards with major public health implications, should be reconsidered.
- Additional environmental health data should be collected. Data are lacking in Israel on trends in sperm quality and age of thelarche, impact of environmental contaminants on ADHD and IQ, and data on BFRs in indoor environments.

Children are our future. Increased efforts should be made to monitor their exposures to environmental contaminants (biomonitoring, monitoring of indoor air and pesticides in schools and daycare centers), and to prevent their exposure to environmental contaminants, especially indoor and outdoor air pollution, pesticides, environmental tobacco smoke, and chemicals in consumer products and food.



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