



Environmental Health in Israel 2017



הקרן לבריאות וסביבה
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Environment and Health Fund



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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.

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Preface

In this second edition of *Environmental Health in Israel*, you will find a snapshot of the state of Israeli environmental health circa 2017. There are 14 chapters dealing with environmental exposures that affect human health, from pesticides to planning, chemicals in consumer products to climate change. Most importantly, this volume makes good on the commitment made in the first edition, to regularly measure and assess the progress in the field since outlining a set of challenges in the 2014 publication.

As can be seen at the end of each chapter and in the overview presented in the Appendix, there has been progress across a range of issues in the period between 2014 and 2017. However, a quick glance at the remaining red flags shows that there is still much to do. The population of Israel continues to be exposed to high levels of pollution, higher than those acceptable in other parts of the developed world. Of particular concern are the exposures that occur in the areas where Israel has taken the lead, namely, in the use of treated wastewater for the irrigation of edible crops and in the use of desalinated water to augment the drinking water supply. As other countries may look to Israel to provide responses to water scarcity resulting from the effects of climate change, it is incumbent upon the Israeli environmental health community to gain a better understanding of the potential health consequences of these innovations.

What we understand in 2017, even more than we did in 2014, is the breadth of the engagement necessary in order to protect the public from environmental hazards. Land use planning is not oriented enough to the public health consequences of decisions taken, and the failure to include Health Impact Assessment as part of the planning process should be rectified. The Ministry of Health should have an amplified

voice in dealing with the Ministry of Economy regarding safe levels of chemicals in consumer products. Reducing burdensome regulations and lowering the cost of living in Israel are worthy endeavors. And yet for regulations designed to safeguard public health, reducing costs must be balanced with requirements of health and safety. This is particularly important in the case of regulating chemicals in consumer products.

We do not do enough in Israel to protect the most vulnerable populations. We must ask ourselves whether there is any reason that a child in Israel should be exposed to higher levels of lead, higher levels of pesticides, or higher levels of flame retardants than a child in Denmark or in Canada. And if the answer is “no” then we have our work cut out for us. These are issues that should be important to consumers, and Israel would benefit from stronger consumer advocacy on issues of toxic chemicals.

I would like to thank the many individuals who contributed to this volume. Prof. Itamar Grotto, the Deputy Director General at the Ministry of Health, has been a champion of environmental health for the past decade and continues to steward these efforts, exemplifying the best of public-private partnership. Thanks to Dr. Tamar Berman whose hard work has been indispensable and whose commitment is extraordinary. We thank Dr. Zohar Barnett-Itzhaki who worked tirelessly on this report. Many contributors and expert reviewers also helped with the content of the chapters. We also thank Dr. Henry Falk, Dr. Stanley Meiburg and Prof. Erik Lebret who participated in a two-day workshop in January 2017 that began the process of preparing the report. They made valuable contributions and Henry Falk offered very helpful comments on the first draft of the report. Dr. Linda Birnbaum, Director of the National Institute of Environmental Health Sciences, reviewed and commented on earlier drafts of every chapter in this report and wrote the Conclusions and Recommendations chapter. We continue to be awed by her ability to clearly and concisely point the field, both in Israel and internationally, in the right direction. Particular thanks go to Dr. Sari Rosen and to Na'ama Shilony who formally are recognized for editing and production but that does not do justice to their investment of time and effort to meet their own uncompromising standards of excellence in all things.

Ruth Ostrin, PhD
Director
Environment and Health Fund

Introduction

Environmental health addresses the multiple effects of the environment on individuals' health and quality of life. Dealing with environmental health in Israel is especially challenging. As a small, densely populated country with limited natural resources, Israel faces a broad range of environmental health challenges. These include industrial and agricultural development in close proximity to residential areas, use of desalinated water resources for drinking and treated wastewater for agricultural irrigation, and the establishment of sustainable transport systems.

Environmental health in Israel often receives attention as the result of crises such as air pollution in Haifa, cases of pesticide poisoning, and high concentrations of metals in coffee machines. The process of preparing the current report, *Environmental Health in Israel 2017*, gives us an opportunity to pause, to examine, and to produce an integrated evaluation of what is being done and what progress is being made in this field - and to identify challenges and objectives for the future.

In recent years, there has been significant progress in various aspects of environmental health in Israel: scientific breakthroughs, for example on exposure to pharmaceuticals via the food chain; improvements in regulation such as the banning of smoking in schools; and strong cooperation between government and third-sector entities on diverse matters such as mitigating the public's exposure to pesticides. Furthermore, in 2016 the government resolved to draft a national program for environmental health in order to evaluate environmental hazards that have adverse health effects, and to allocate a budget for their mitigation, in order to protect the health and quality of life of the public today and for generations to come.

We do, however, face many challenges. Knowledge gaps exist in regard to the effect of environmental exposures on human health, risk assessment in diverse fields is lacking, and there is growing use of emerging compounds, along with various types of radiation in technological and industrial development. In addition, health aspects are sometimes overlooked for the sake of accelerated development (construction and roads), programs to reduce cost-of-living, and efforts to streamline regulation in Israel.

Our previous report, *Environmental Health in Israel 2014*, was the result of cooperation between the Israel Ministry of Health and the Environment and Health Fund. The 2014 report was helpful in defining specific tasks in the field of environmental health for the Ministry of Health. The current report documents scientific and regulatory progress over the past few years in the areas of environmental health that were covered in the previous report. Three additional important environmental health topics are included in this new report: wastewater, planning, and vulnerable populations. This report gives us an opportunity to assess performance and progress in environmental health in Israel. In retrospect, there has been significant progress on many of the goals set forth in the 2014 report. The current report also aims to identify challenges and goals for upcoming years, as a basis for government policymaking in environmental health.

This report is the outcome of cooperation among various departments within the Ministry of Health in conjunction with other government offices, institutional players, experts from academia, and NGOs. Preparations for the report were launched at a two-day workshop attended by international experts in environmental health and Israeli experts from academia and NGOs. The diverse ideas and perspectives presented at the workshop and in the subsequent consultation process made a major contribution to the report.

At this opportunity, I wish to thank all those who took part in preparing this report—particularly Dr. Ruth Ostrin of the Environment and Health Fund and Dr. Linda Birnbaum, Director of the U.S. National Institute of Environmental Health Sciences. Gratitude is also owed to Dr. Tamar Berman and Dr. Zohar Barnett-Itzhaki, who led the preparation of the report.

Prof. Itamar Grotto, MD, MPH, PhD
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Ambient Air Quality

Sources of ambient (outdoor) air pollution include natural phenomena such as dust storms, and anthropogenic activity such as emissions from industry, transportation, and households. Exposure to ambient levels of air pollutants, even at low concentrations, is associated with a wide range of adverse health effects in the general population, and particularly in vulnerable populations, including children, pregnant women, individuals with chronic illness, and the elderly⁽¹⁷⁾. Adverse health effects of air pollution include respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD), cardiovascular morbidity, specific types of cancer, adverse neurodevelopmental effects, adverse birth outcomes, type 2 diabetes, obesity, and cognitive impairments.

Scientific evidence suggests that the major air pollutants associated with adverse health effects are particulate matter (PM) of various diameters (for example: PM_{2.5}, which is PM with diameters of up to 2.5 micrometers), ozone (O₃), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂). Additional ambient air pollutants, including benzene, formaldehyde, and some polycyclic aromatic compounds, are known human carcinogens⁽³⁷⁾. The International Agency for Research on Cancer (IARC) classified outdoor air pollution as carcinogenic to humans (Group 1)⁽¹⁰⁾.

Policy and Regulations

Air Standards and Monitoring

Ambient air quality is regulated under the Clean Air Law, which was approved in 2008 and entered into force in January 2011. Air quality values for different pollutants, which were set by the Ministry of Environmental Protection (MoEP) in collaboration with the Ministry of Health (MoH) and other stakeholders, entered into force in 2013. According to the Clean Air Law, industrial plants are required to obtain emission permits and to reduce emissions based on best available technologies (BAT). In 2016, the MoEP updated the target and environmental standards for ambient trichloroethylene, benzene, cadmium, and formaldehyde, and added environmental standards for ambient 1,3-butadiene and mercury (Table 1)⁽¹¹⁾.

Ambient Air Quality Standards ($\mu\text{g}/\text{m}^3$) in 2017 compared with 2011

→
Table 1
 Source: Israel Ministry of Environmental Protection⁽¹¹⁾

Pollutant	2011	2017	World Health Organization (WHO) Guideline Values (2000)
Benzene	5 (annually)	3.9 (daily) - maximum of 7 exceedances 1.3 (annually)	1.7*
1,3-Butadiene	-	0.3 (daily) 0.3 (annually)	-
Cadmium (in PM₁₀)	5 ng/m ³ (annually)	5 ng/m ³ (daily) 5 ng/m ³ (annually)	5 ng/m ³
Formaldehyde	100 (30 minutes)	15 (hourly) - maximum of 10 hourly exceedances 3.3 (annually)	100 (30 minutes)
Mercury	-	0.6 (hourly) in TSP 0.03 (annually)	1 (inorganic mercury vapor)
Trichloroethylene	1000 (daily)	2 (daily) 2 (annually)	23*

* Based on excess lifetime risk of cancer of 1 in 100,000 persons.

Ambient concentrations of air pollutants are routinely monitored in Israel by a network of 146 air quality monitoring stations that measure criteria pollutants (O₃, SO₂, PM_{2.5}, PM₁₀, nitrogen oxides [NO_x], NO₂, carbon monoxide, benzene), and 18 sampling sites that measure non-criteria pollutants (such as volatile organic compounds [VOCs], poly-aromatic-hydrocarbons [PAHs], aldehydes, metals, ammonia, and hydrogen sulfide). The stations are operated by the MoEP, local authorities, municipal environmental associations, the Israel Electric Company, industry and the port authorities. In total, 21 pollutants are monitored, including criteria pollutants and non-criteria pollutants.

In certain locations, there is annual screening of additional contaminants, including dioxins and furans. All measurements are under MoEP quality control and are conducted according to International Organization for Standardization (ISO) standards. In 2016, the MoEP started monitoring black carbon and particles less than 1µm in diameter (PM₁).

National Plan to Reduce Air Pollution in Haifa Bay

Following a 2015 government decision, implementation of the 2015-2020 National Plan to Reduce Air Pollution in Haifa Bay began in 2016. The National Plan, which has a budget of NIS 115.5 million, is expected to reduce industrial air pollution in Haifa Bay by 50%^(16,18). The plan includes designating Haifa Bay a low-emission zone; restricting the use of Haifa's main roads by heavy trucks during rush hour; mandatory vapor recovery systems at gas stations in Haifa Bay; financial support for operating 25 electrical buses and 200 electrical car-share systems in Haifa; compulsory particle traps on polluting vehicles in the city of Haifa; and additional monitoring stations and sampling in the Haifa Bay area⁽¹⁵⁾.

As part of the National Plan, the MoEP, in collaboration with the MoH, published a call for epidemiologic studies and surveys in Haifa Bay, and several epidemiological studies were funded. In addition, the program includes a health outcome monitoring system for infants, school-aged children, and adults. The program, run by the MoH, includes monitoring of type 2 diabetes, asthma, cardiovascular and respiratory diseases, and cognitive outcomes.

Additional Policy and Regulation Issues

The MoEP recently proposed new national standards requiring gas stations to install vapor recovery systems in order to reduce hydrocarbon emissions. The MoEP, in collaboration with the MoH and Ministry of Transportation, is promoting regulations regarding emissions of SO_x, NO_x, benzene, and heavy metals from marine vessels in order to reduce air pollution in harbors and their surroundings.

A significant number of charcoal kilns operating in the Palestinian Authority cause severe ambient air pollution and odor that affect both Palestinian and Israeli residents in the surrounding areas. Following a governmental decision, an inter-ministerial committee (Ministry of Agriculture and Rural Development, MoH, MoEP, Ministry of Economy, Ministry of Finance, and the Israel Electric Corporation) was established in 2015 to address this problem. The committee recommended prohibiting the transfer of raw materials (wood) from Israel to the Palestinian charcoal kilns and the transfer of coal from the Palestinian Authority to Israel⁽¹⁴⁾.

The MoH, in collaboration with the MoEP, the Ministry of Education, and the Ministry of Labor, Social Affairs and Social Services, is promoting a program for directors of educational and welfare institutions to raise awareness regarding severe air pollution events and their health effects. The ministries are working on improving the flow of information to and within the educational and welfare systems in cases of severe air pollution events⁽¹⁹⁾.

In 2016, the MoH and the MoEP, in collaboration with the Israeli Football Association, published guidelines for cancelling professional and semi-professional football games and other competitive sports during extreme air pollution events.

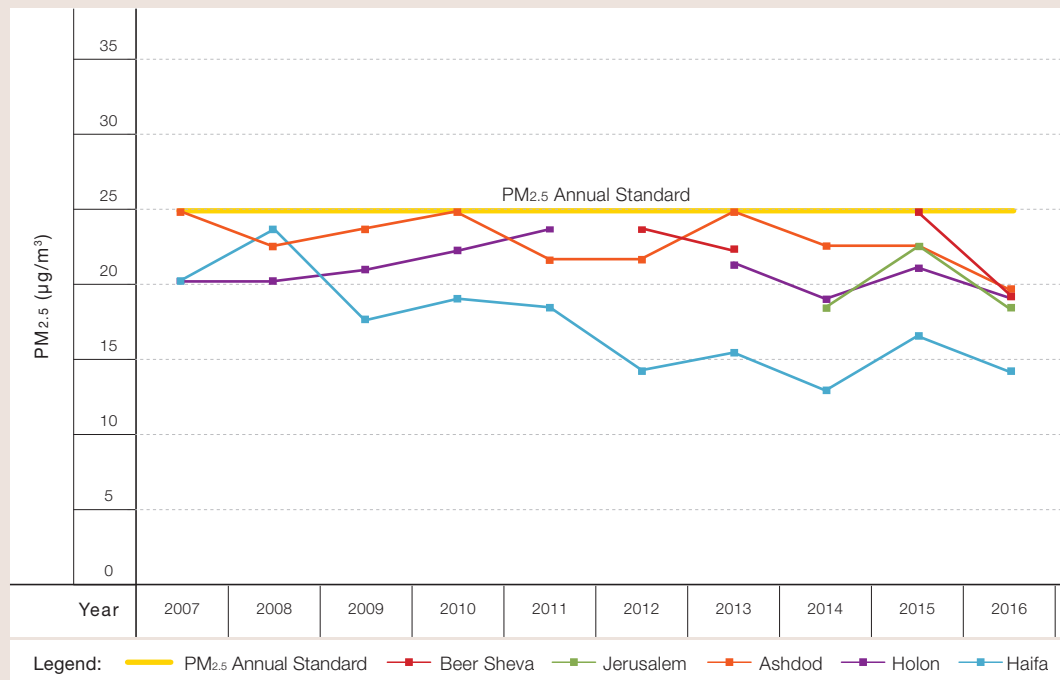
According to a 2017 decision by the National Planning and Building Council regarding urban renewal projects, the minimum distance between small gas stations (up to 4 gas pumps) and sensitive locations, including residences and schools, was reduced from 40 meters to 20 meters.

Data on Air Pollution in Israel

Data from the Pollutant Release and Transfer Register (PRTR) published in 2016 showed a significant decrease in reported emissions of CO₂, NO_x, SO₂, PM, and VOCs (except methane) between 2012 and 2015; for example, a reduction of 34% in SO₂ and NO_x, and of 14% in non-methane VOCs (NMVOC). The significant decrease in SO₂ is due to the improved quality of fuel used in Israel in recent years and the increased use of natural gas for the production of power and in some industrial facilities. However, since 2012, there has been a steady increase in emissions of methane, a potent greenhouse gas⁽¹²⁾. Measurements at monitoring stations indicate a decrease in concentrations of PM_{2.5} during the last decade (Figure 1). In 2016, there were 466 measurements that exceeded the environmental standard for daily mean PM_{2.5}; many of them were due to meteorological conditions that induced the spread of mineral dust from deserts in Israel's geographical surroundings.

Annual Concentrations of PM_{2.5} (µg/m³) - Trends in Representative Areas, 2007-2016

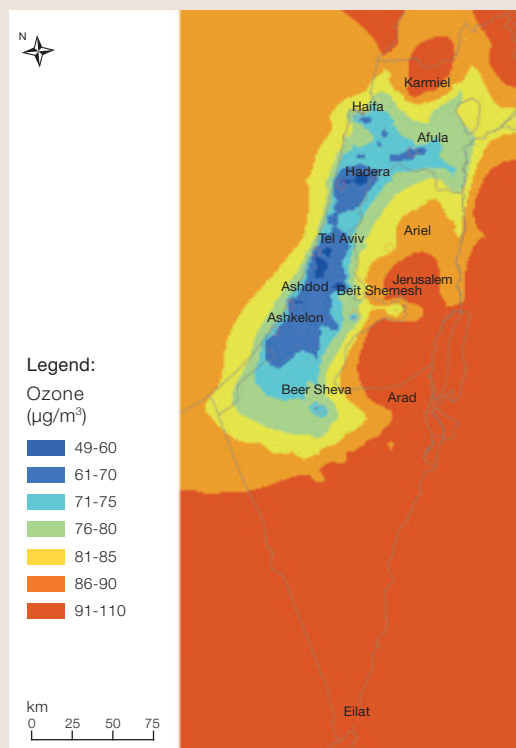
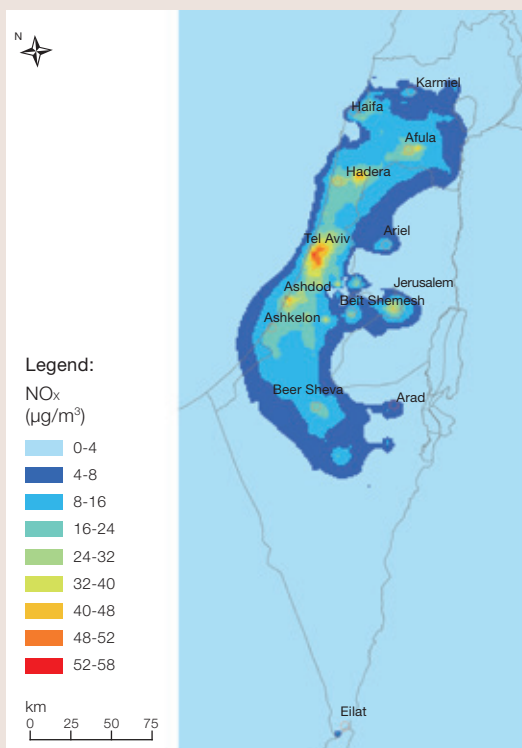
→
Figure 1
 Source: Israel
 Ministry of
 Environmental
 Protection



Although NO_x emissions have been decreasing in recent years, relatively high levels have been measured in major cities (especially in Tel Aviv), and in areas adjacent to power plants (Hadera, Ashdod and Alon Hatavor) (Figure 2). Ozone levels have not decreased in recent years. The highest concentrations of ozone are detected in regions far from emission sources, such as Judea, Samaria and the Galilee (Figure 3).

NO_x Concentrations in Israel, Based on Integrated Monitoring and Air Quality Models, 2015

Ozone Concentrations in Israel, Based on Integrated Monitoring and Air Quality Models, 2015



← **Left - Figure 2**
Source: Israel Ministry of Environmental Protection

Right - Figure 3
Source: Israel Ministry of Environmental Protection

Researchers from the Technion Center of Excellence in Exposure Science and Environmental Health (TCEEH) built an air pollution database for use by the research community. The database includes a variety of data, such as air pollutant monitoring and meteorological data.

Data on Disease Burden and Costs Associated with Air Pollution in Israel

According to the Global Burden of Disease database, the number of deaths attributed to PM exposure in Israel decreased between the years 2000 and 2015 from a rate of 29 per 100,000 people in 2000 to a rate of 26.5 per 100,000 people in 2015⁽⁸⁾. However, due to population growth, the absolute number of deaths rose during these years from 1,740 to 2,133. According to this database, exposure to PM_{2.5}, as calculated using population-weighted concentrations, rose in Israel over the past 25 years, and rose at a faster rate than the Organization for Economic Co-operation and Development

(OECD) average during the past decade (Figure 4). This increase is attributable to higher exposure in populated areas. The fact that the population in Israel is concentrated in highly polluted areas partly explains why the rate of increase is higher than the OECD average⁽³²⁾. It should be noted that air pollution data in the Global Burden of Disease database are based on ground measurements and satellite observations, and that there is room for additional analyses in Israel.

Population-Weighted Annual Mean Exposure to PM_{2.5} in Israel and the OECD Average, 1990-2015

→
Figure 4
 Source:
 State of Global Air⁽³²⁾



According to an OECD Environment Directorate published in 2017, there were 2,240 deaths in Israel due to air pollution in 2015, and an overall increase in the mortality rate as a result of air pollution between 2010 (238 per million) and 2015 (265 per million). The report estimated the cost of mortality due to air pollution in 2015 at \$7.3 billion⁽²⁷⁾.

In 2016, MoH researchers analyzed the association between exposure to PM_{2.5} and the risk of a wide range of adverse health outcomes, including respiratory and cardiovascular disease, cancer, diabetes, and low birth weight. The researchers used the WIDE Model (entailing a comprehensive and broad examination of respiratory / cardiovascular diseases) and estimated that exposure to PM_{2.5} in 2015 led to 1,908 deaths, 348,039 hospitalization days, and a cost of \$1.03 billion (Table 2)⁽⁷⁾.

Deaths and Hospital Days due to PM_{2.5} Exposure in Israel and the Associated Costs, 2015

→
Table 2
 Source:
 Ginsberg et al.,
 2016⁽⁷⁾

	Estimated PM _{2.5} Costs and Effects According to the WIDE Model (percent of total)
Deaths	1,908 (4.3%)
Hospital Days	348,039 (6.7%)
General Hospital Costs	\$318,918,656 (7.1%)
Total Health Costs	\$1,027,757,036 (4.6%)

Research on Ambient Air Pollution in Israel (Published 2014-2017)

Exposure

Researchers from TCEEH and the Hebrew University of Jerusalem developed a system for predicting air pollution, using a land use regression (LUR) statistical model, and demonstrated that the model can be used to determine historical NO_x concentrations due to on-road vehicles from 1961 to 2011 - even before measurements were available⁽²³⁾.

In 2016, TCEEH researchers showed that signals from GPS transmitters mounted on vehicles can be used as a proxy for traffic emissions, and to develop maps with very high spatiotemporal resolution of concentrations of primary air pollutants, which can be used for exposure assessment⁽²⁾.

In 2017, TCEEH researchers showed that studies on air pollution exposure that rely solely on residential address may result in exposure misclassification, and that accounting for daily commuting may be important in some circumstances^(30,31).

Researchers from Ben-Gurion University of the Negev (BGU) examined the spatiotemporal distribution of PM during dust storms in southern Israel, in the city of Beer Sheva, and found variance in PM concentrations in different parts of the city. Higher concentrations were found in areas of the city closer to dust sources⁽²¹⁾.

Researchers from BGU and TCEEH, together with colleagues from Harvard University and NASA, developed a model for assessing air pollution (PM_{2.5} and PM₁₀) using hybrid models that include satellite information⁽²⁰⁾.

Biochemical Effects

In 2016, Weizmann Institute of Science and BGU researchers showed that repeated exposure to PM suppresses pulmonary defense mechanisms, resulting in lipid and protein oxidative damage⁽²⁸⁾.

In a study published in 2016, BGU researchers demonstrated that exposure to PM₁₀ is associated with increased levels of serum glucose, hemoglobin A1c, low-density lipoprotein and triglycerides, and decreased levels of high-density lipoprotein, especially among people with diabetes⁽³⁹⁾.

In 2015, researchers from BGU showed that NO₂ and SO₂ exposure is associated with a small, yet statistically significant, increase in serum glucose levels⁽⁴⁰⁾.

Respiratory Diseases

BGU researchers found in 2014 that daily PM₁₀ concentrations were extremely high during dust storm days, and that there is a positive association between dust storms and rate of hospitalization for COPD exacerbation. The effect increased with age and was higher in women. The researchers concluded that short-term exposure to natural PM₁₀ during dust storms increases the risk of hospitalization for COPD exacerbation⁽³³⁾.

In 2015, researchers from the Hebrew University of Jerusalem and the University of Haifa showed that sandstorms lead to an increase in PM₁₀ concentrations, which results in increased hospital admissions due to respiratory conditions⁽⁵⁾.

Researchers from Tel Aviv Sourasky Medical Center showed in 2015 that exposure to PM_{0.1} (ultrafine particulate matter with diameters measuring less than 0.1 micron) correlates with high levels of respiratory symptoms and airway inflammation in children with asthma⁽¹⁾.

In a paper published in 2015, BGU researchers noted an increased risk of asthma medication purchase associated with mild dust storms. The risk observed for hospitalization was more pronounced among the rural Bedouin population in southern Israel⁽⁴²⁾.

In a paper published in 2016, BGU researchers demonstrated that natural PM (for example, due to dust storms) increased the risk of hospitalization for pneumonia, particularly among patients above the age of 65 and cardiac patients⁽³⁵⁾.

A study published in 2015 by researchers from the Hebrew University of Jerusalem, BGU, and Clalit Health Services suggested that residential proximity to a hazardous industrial site may contribute to hospital admissions for respiratory illnesses in early childhood⁽²⁴⁾.

In a paper published in 2015, Hebrew University of Jerusalem researchers noted an increased risk of hospitalization for respiratory infections related to residential exposure to traffic-related air pollution among girls ages 5 to 14 and boys ages 0 to 4. The findings indicate possible differential associations between traffic-related air pollution and pediatric hospitalization among boys and girls in different age groups⁽²⁵⁾.

In 2015, University of Haifa researchers published a review of studies on the respiratory effects of air pollution in Israel. The researchers found contradictory results in the various studies, specifically in studies that investigated the association between PM₁₀ and asthma, and attributed these discrepancies to different research methodologies and different types of data⁽⁹⁾.

Cardiovascular Diseases

Researchers at BGU published a paper in 2015 demonstrating that exposure to PM₁₀ and PM_{2.5} is associated with a higher risk of ischemic stroke in adults under the age of 55⁽⁴¹⁾.

BGU researchers showed in 2015 that exposure to non-anthropogenic PM is associated with cardiovascular morbidity, and that the most vulnerable groups were older women and Bedouins. These findings provided evidence of an association between air pollution (NO₂), weather, and visits to hospital emergency departments for headaches. The researchers suggest that short-term increases in air pollution may trigger headaches in various ways - for example, by increasing pulmonary and systemic inflammation, increasing blood coagulability, and altering endothelial function^(34,36).

Cancer

In a paper published in 2017, TCEEH, Hebrew University of Jerusalem and Tel Aviv University researchers showed that chronic exposure to traffic-related air pollution may constitute an environmental risk factor for cancer among post-myocardial infarction patients. A 10-ppb increase in mean NO_x exposure was associated with a higher risk of cancer, in particular lung, bladder, kidney and prostate cancer⁽⁴⁾.

Pregnancy and Birth Outcomes

BGU and MoH researchers published findings in 2016 demonstrating an association between in utero exposure to ambient air pollution and proliferation of umbilical cord blood cells. Specifically, lower cell proliferation (CP) of umbilical cord blood cells was associated with exposure to ambient ozone levels, 1-4 days before delivery; with exposure to increased PM_{2.5} or PM₁₀, 5-6 days before delivery; and with exposure to carbon monoxide (CO) levels on the delivery day and the previous day⁽²⁶⁾.

In 2015, researchers from BGU and the MoH studied a population of pregnant Bedouin women and found that exposure to NO₂ had an impact on minor congenital malformations, while major congenital malformations depended mostly on the household environment⁽²²⁾.

A study published in 2014 by researchers from the Gertner Institute for Epidemiology and Health Policy Research, in collaboration with the Weizmann Institute of Science and Tel Aviv University, indicated a possible association between exposure to air pollution (PM₁₀ and NO_x) and the risk of congenital malformations, specifically in the circulatory system and genital organs. Additionally, the researchers identified a possible adverse effect of exposure to SO₂ and ozone on assisted reproductive technology (ART) pregnancies⁽⁶⁾.

Mortality

A study published in 2017 found that the transition from coal or high sulfur oil to natural gas led to a reduction in SO₂ and PM_{2.5} concentrations in Tel Aviv, Haifa, and Ashdod. A meta-analysis that combined results from the three cities showed a statistically significant reduction in cardiovascular events (-13.3%), and a borderline significant reduction in total mortality (-19%) following the transition to natural gas⁽³⁸⁾.

Current Research on Air Pollution in Israel: Assessing Exposure and Health Outcomes

- ♦ In the framework of the National Plan to Reduce Air Pollution in Haifa Bay, a number of epidemiological studies including birth cohorts will be funded. Additional studies will examine the association between air pollution and asthma and cancer in army recruits, and the costs associated with the air pollution-related burden of disease.

- ♦ Researchers from the Hebrew University of Jerusalem, the Technion, Shahal Medical Services, and Rabin Medical Center are using telemedicine data to examine associations between acute cardiovascular events and ambient PM levels (measured at monitoring stations).
- ♦ Researchers from the Hebrew University of Jerusalem, TCEEH, and BGU are studying the association between exposure to various air pollutants during pregnancy and the risk of autism spectrum disorder.
- ♦ BGU researchers are studying the association between adverse birth outcomes and exposure to ozone in the Negev (southern Israel); and the association between maternal exposure to PM₁₀ and infections in the infant's lower respiratory tract during the first year of life.
- ♦ TCEEH researchers are participating in an international consortium on air-quality micro-sensing units (personal sensors) and are conducting research on this technology in the Haifa area.
- ♦ BGU researchers are examining the association between personal/indoor exposure to air pollution (NO₂, PM_{2.5} and black carbon) and blood sugar levels among healthy people and among people with type 2 diabetes.
- ♦ Researchers from the Hebrew University of Jerusalem, TCEEH, and the MoH are studying the association between exposure to PM and thyroid hormone levels in newborns.
- ♦ Tel Aviv University researchers are developing a system to distinguish among various sources and levels of air pollution in urban areas, using satellite remote-sensing techniques.
- ♦ BGU researchers are developing a model for high-resolution daily temperature forecasts that will enable a more precise assessment of exposure in both urban and rural areas. This model will be used together with a model for assessing PM_{2.5} exposure, to examine the association between these factors and various birth outcomes, including low birth weight, premature birth, premature rupture of membranes (PROM), congenital malformations, and pre-eclampsia.

Progress since 2014

In *Environmental Health in Israel 2014*, the major challenges highlighted in the field of ambient air pollution included the need for updating target and air quality standards; developing a strategy for the regular sampling of contaminants that are not monitored continuously; reducing ambient concentrations of PM₁₀ and ozone in metropolitan areas; improving the spatial distribution of monitoring air stations in Israel; and integrating transport and land use planning.

Significant progress has been made in updating target and air quality standards (for benzene,

1,3-butadiene, cadmium, formaldehyde, mercury, and trichloroethylene). The spatial coverage of the air quality monitoring network and the range of sampled contaminants improved following the addition of eight air quality monitoring stations since 2014 and the monitoring of two additional pollutants (black carbon and PM₁) in 2016. There was some progress in reducing ambient concentrations of PM₁₀, NO₂, and SO₂, and a slight decrease in PM_{2.5}, but no progress was made in reducing ambient ozone. There has been little progress in integrating transport and land use planning.

Major Challenges

In the past decade, there has been a significant increase in the scope and depth of research on ambient air pollution and its health effects in Israel. This research has highlighted the unique characteristics of air pollution in Israel. Data from the numerous epidemiological studies conducted in Israel should be utilized to assess the disease burden from air pollution and the costs it entails.

Research on, and the monitoring of, transboundary air pollution using source apportionment techniques will provide a better understanding of the relative roles of various sources and of the appropriate measures required to reduce pollution. Due to high background concentrations of certain air contaminants, Israel will probably be unable to reach target levels through national actions (within its borders) alone. Source apportionment techniques are also vital for evaluating measures to reduce local pollution. An economic analysis of the cost of environmental pollution in Israel published in 2017 showed geographic variation in the sectors driving major air pollution costs. In the Haifa District, the energy sector was responsible for 75% of the air pollution costs, while in the Tel Aviv and Jerusalem districts, transportation was the dominant sector, responsible for 83% and 71% of the costs, respectively⁽¹³⁾.

Following a government decision in 2015, significant efforts and resources were directed at reducing ambient air pollution in Haifa Bay. It is important to designate additional urban areas in Israel as low emission zones, and to reduce the burden of disease associated with air pollution not only in "hot spots" but also in areas with average pollution levels. There is a need to improve the methods for evaluating exposure levels to air pollution and to produce a more accurate calculation of the burden of disease and the costs attributed to the range of actual exposure across the population.

Traffic is a major source of air pollution, but not enough resources are being invested in public transportation. The number of cars purchased annually in Israel continues to increase (according to the Central Bureau of Statistics, 272,000 private vehicles were purchased in Israel in 2017). There is a need to increase investments in public transportation and to adopt innovative measures to reduce traffic, for example, by creating a social infrastructure for car sharing. Reducing traffic and the number of privately owned vehicles would undoubtedly contribute to improving ambient air quality. The National Plan to Reduce Air Pollution from Transportation, approved in 2016 and budgeted at NIS 260 million, is expected to lead to improvements in 2017-2018.

Despite noteworthy reductions in emissions in Israel in recent years, there are still over 2,000 deaths attributable to air pollution in Israel every year⁽²⁷⁾. The costs associated with air pollution exceed \$7 billion annually. In 2013, the government approved a National Program to Reduce Air Pollution, but the program was only partially funded. Although some parts of the program have been fully implemented (for example, encouraging the use of public transportation in workplaces and quantifying emissions of respirable particles from quarries), other major parts have yet to be implemented (for example, scrapping old private cars, promoting the purchase of buses powered by natural gas, and taxing fuels differentially)⁽³⁾. An analysis of the burden of disease in Israel and its related costs could provide guidelines to help policymakers and decision makers optimally allocate funds to reduce air pollution⁽²⁹⁾.

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Indoor Air Quality

Indoor air quality (IAQ) refers to air quality inside closed environments, such as buildings and their surroundings, including private homes, offices, public buildings such as schools and hospitals, as well as mass transport systems. Poor IAQ may impact the health of individuals living or working in the building and its surroundings. Indoor air pollutants may include toxic gases (such as carbon monoxide [CO] and nitrogen oxides [NO_x]), radon, volatile organic compounds (VOCs such as formaldehyde, benzene, toluene, and styrene), respirable particles (particulate matter [PM]), combustion products, pesticides, volatile flame retardants, tobacco smoke (second-hand and third-hand), biological pollutants (such as mold and bacteria), and other pollutants, such as asbestos fibers. Indoor biofuel cooking and heating are major potential sources of indoor air contamination. IAQ is mostly affected by three factors: (a) indoor sources of pollutants and materials, (b) the quality of ambient air entering the building, and (c) the air exchange rate between the indoor and the outdoor environment.

Poor IAQ has been associated with short-term health effects, such as upper and lower respiratory tract infections, allergic reactions, irritation of the eyes, nose, and throat; headaches, dizziness, and cognitive impairment; and also with long-term health effects, such as respiratory diseases (asthma, chronic obstructive pulmonary disease [COPD]), bronchitis, heart disease, and cancer. Exposure of young children to poor IAQ is associated with an increased risk of pneumonia and influenza.

Policy and Regulations

The Clean Air Law (2008) does not specifically refer to indoor air. Most of the regulations regarding indoor air (radon, ventilation requirements) are specified in planning and building standards.

Based on concerns regarding vapor intrusion of chlorinated organic compounds from contaminated land, in 2016 the Ministry of Environmental Protection (MoEP) published recommendations to prevent and measure indoor air contamination from vapor intrusion⁽⁵⁾.

In 2015, the Ministry of Health (MoH) mapped the main IAQ hazards that require special attention in Israel, such as exposure of the Bedouin population to household biomass combustion products, and exposure to radon. In 2017, MoH researchers published a position paper regarding the potential health implications of studying in schools and kindergartens in high-rise buildings due to poor IAQ. The researchers determined that IAQ should be given special attention during the planning and construction of high-rise buildings⁽¹⁾.

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 the accumulation of high radon levels. In addition, the regulations set maximum permissible indoor radon levels. The action level for radon concentrations in Israel is 200 Becquerel/m³ (Bq/m³), which is higher than the United States Environmental Protection Agency (EPA) action level (approximately 148.14 Bq/m³)⁽⁷⁾.

Israeli Standard 5281, which is a voluntary Green Building Standard, refers to sustainable building and addresses issues related to ventilation, the use of raw materials that do not emit toxic chemicals, and the quality of ambient air entering the building. The standard was updated in 2016 and currently refers to the reduction of VOCs and radioactive emissions from building materials. Of note, following a request from the MoH, the recommendation to install air ionizers was removed from the standard since there are no studies that support the contribution of air ionizers to enhanced IAQ.

The 2011 Israeli Standard 6210, "Ventilation for Acceptable Indoor Air Quality," which is based on the 2010 United States standard, defines permitted values for select indoor contaminants (including sulfur dioxide [SO₂], nitrogen dioxide [NO₂], carbon monoxide [CO], particulate matter of up to 10 micrometers [PM₁₀], and benzene). The standard was adopted by the National Committee for Planning and Construction as part of the mandatory Planning and Construction Standards, and is pending approval by the Ministry of Justice.

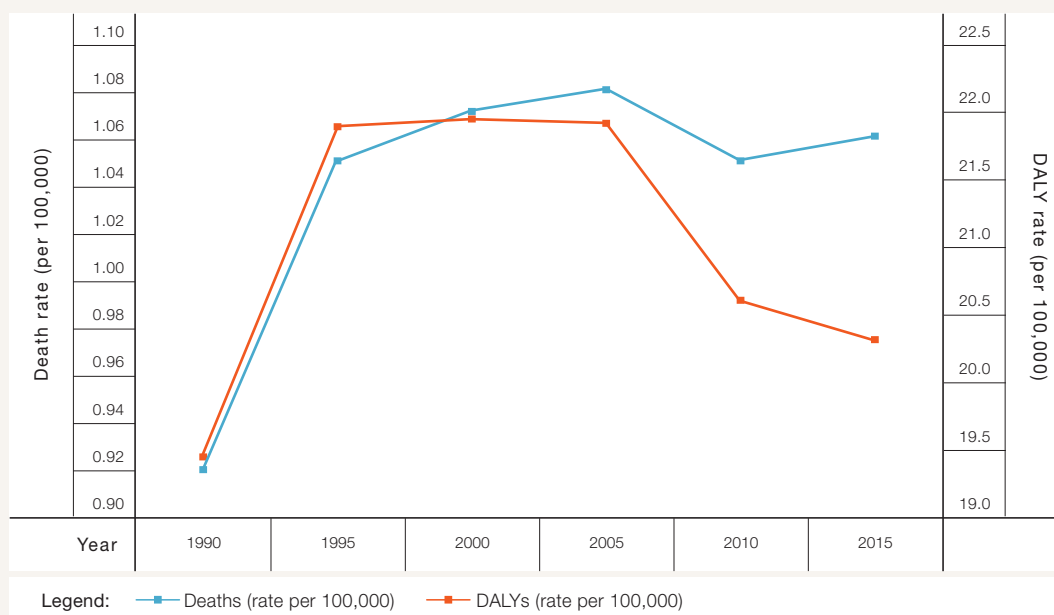
Data on Indoor Air Quality in Israel

A study by the MoEP and researchers from Hadassah Academic College analyzed data from 8,624 radon measurements conducted between 1991 and 2012. The percentage of rooms with radon

concentrations above the action level for homes in Israel (200 Bq/m³) ranged from 10% in radon-prone geographical areas to 6% in geographical areas that are not radon-prone. Of note, there was a steady increase in radon concentrations between 1997 and 2012. As expected, the highest concentrations were found in radon-prone geographical areas, residential secure spaces (which have thick concrete walls), and ground-floor rooms⁽¹¹⁾.

According to the Global Burden of Disease database, the death rates and disability-adjusted life years (DALY) rates due to residential radon increased dramatically in Israel between the years 1990 to 2005, and have decreased in the last decade (Figure 1)⁽⁴⁾.

Death Rates and Disability-Adjusted Life Years (DALYs) due to Residential Radon Exposure in Israel, 1990-2015



←
Figure 1
 Source:
 Global Health Data
 Exchange 2017⁽⁴⁾

Due to concerns about excessive air pollution at bus platforms at the Central Bus Station in Jerusalem, the MoEP has been continuously monitoring levels of criteria air pollutants. The results indicate NO₂ levels in excess of warning values and high short-term concentrations of PM_{2.5}.

The MoEP publishes data from monitoring stations for PM_{2.5}, NO₂, and NO_x at several transportation sites, such as the Jerusalem Central Bus Station, the Tel Aviv Central Bus Station, and several railway stations, mostly in central Israel. During the period of December 2014 to February 2015, the MoEP monitored 49 exceedances of PM_{2.5} (during 82% of this period); 454 exceedances of NO₂ (during 42% of this period); and 1,189 exceedances of NO_x (half hourly, during 42% of this period) at Platform 1 at the HaShalom Railway Station, apparently due to the train emissions and the proximity of the platform to the Ayalon highway⁽⁹⁾. During the period between March 2016 and June 2016, PM_{2.5}, NO_x and NO₂ were measured at both the HaShalom and Yoseftal railway stations. There were 55 and 44 PM_{2.5} exceedances, respectively (during

51% of the days when measurements were taken at HaShalom and during 57% of the days when measurements were taken at Yoseftal). There were many reported exceedances of NO_x (half hourly) and NO₂. Of note, data are presented in comparison to air quality standards⁽⁶⁾.

Technion researchers recently conducted air pollution measurements and evaluated the passengers' exposure to pollution in several locations: (a) the Jerusalem Central Bus Station and in the departing buses; and (b) the HaShalom Railway Station and in the departing trains. Extremely high average concentrations of ultrafine respiratory particles ([UFP], up to $1.9 \times 10^5 \text{ cm}^3$) were measured at HaShalom train station platforms at peak hours. Low average UFP concentrations (below $1.5 \times 10^4 \text{ cm}^3$) were measured in the intercity buses on the Jerusalem-Haifa route.

Research on Indoor Air Quality in Israel

Radon

Researchers from Ben-Gurion University of the Negev (BGU) and the Soreq Nuclear Research Center found that the average radon concentration in apartments in new buildings was statistically significantly higher than in old buildings, and that the average radon concentration in single-family houses was statistically significantly higher than in apartments in multi-story buildings. Higher radon concentrations in new buildings are likely related to the regulations mandating the construction of residential secure spaces that entered effect in the 1990s. The residential secure spaces' massive concrete walls, and the floor and the ceiling that can be hermetically sealed, are designed to protect its residents from a missile attack. The researchers used a model that takes into account the concentrations of the natural radionuclides in building materials, and the density and the thickness of the walls. According to their calculations, the overall annual exposure of the population of Israel to natural sources of ionizing radiation was 2 mSv, with ranges between 1.7 and 2.7 mSv^(2,3).

A Technion study analyzed results of natural radiation tests in concrete produced in Israel, including 109 concrete mixes produced commercially during 2012-2014. The average concentrations of radon were comparable to those in Mediterranean countries, such as Greece, Spain, and Italy. In addition, the average value of the radon emanation coefficient of concrete containing coal fly ash (FA) was lower than that of concrete mixes without FA⁽¹⁰⁾.

Indoor Biomass Combustion

Researchers from BGU and the MoH found that the use of open fire for cooking was highly prevalent among Bedouin women in southern Israel, and was more frequent among women who resided in temporary communities⁽¹²⁾.

Flame Retardants

Researchers at the Technion Center of Excellence in Exposure Science and Environmental Health (TCEEH) are studying the presence of flame retardants in dust that accumulates inside cars. Initial

results show that polybrominated diphenyl ethers (PBDEs) were detected in most samples. No clear association between PBDE levels and vehicle manufacturer, model, or year was identified. Higher levels of PBDEs in car dust were observed in the summer than in the winter. Vehicles were found to possibly be an important microenvironment for PBDE exposure in the Mediterranean climate. These researchers are currently studying the presence of flame retardants in mattresses, including organophosphorous flame retardants.

Indoor-Outdoor Pollution Relationships

BGU researchers in collaboration with TCEEH are studying associations between indoor and outdoor air pollution and their health effects, during different diurnal periods and different seasons of the year in Haifa District municipalities.

Hebrew University of Jerusalem and Technion researchers are exploring ambient and indoor measurements of particulate matter concentrations in the city of Elad, which is near an active, high-production quarry. Continuous measurements are being conducted for a period of one year in private homes and in schools in the surrounding area, and in other locations in Israel, for comparison.

IAQ and Adverse Health Effects

Researchers at BGU are investigating the effect of exposure to indoor air pollution on type 2 diabetes by studying the effect of IAQ on a group of pregnant women living in Haifa and pregnant women living in Beer Sheva.

Progress since 2014

Environmental Health in Israel 2014 highlighted the need for collaboration among the MoEP, the MoH, and the Ministry of Education on a pilot study in schools, and the need for research on residential dust. There has been no progress with the pilot study in schools and only slight progress in research on residential dust.

Major Challenges

Some aspects of IAQ are handled by the MoEP (vapor intrusion) and the Standards Institute of Israel (the Green Building Standard, standards on formaldehyde emissions from wood, pending standards on flame retardants in mattresses). In addition, there are mandatory building standards in Israel regarding radon and building ventilation requirements. However, there is no central authority that handles IAQ. Consequently, IAQ is not a high priority issue and government budgets for research and monitoring in this field are limited. There are very limited data on the impact of consumer products and their components (such as VOCs used in mattress production, cleaning products, and paints) on IAQ.

IAQ is a challenging subject to study due to the broad range of factors that influence it, such as indoor materials, indoor activity, ventilation systems, and ambient air. There are considerable knowledge gaps regarding the health impacts of IAQ, including its effects on vulnerable populations and the relationship between ambient air pollution and IAQ. Since IAQ is dependent on climate and culture, there is a need for local research that focuses on IAQ in Israel.

Indoor combustion - primarily open-fire cooking inside the home, and use of wood or coal burning stoves - has a significant impact on IAQ. Indoor cooking on gas stoves in small unventilated spaces can lead to high NO_x concentrations. Although the MoH published an infographic on IAQ and carbon monoxide (CO) pollution in 2016⁽⁸⁾, there is still a lack of awareness regarding the health impact of indoor combustion and the importance of IAQ. There is a need to formulate and publish clear, science-based recommendations for the public on ways to reduce exposure to indoor contaminants.

The latest data indicate that radon levels are higher in newer residential buildings with residential secure spaces. The MoEP, in collaboration with the MoH, is investigating health effects from radiation due to the use of fly coal ash in the concrete used for building residential secure spaces.

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Environmental Tobacco Smoke

Environmental tobacco smoke (ETS) is a mixture of solid particles and gases containing toxic chemicals, including oxidative gases, heavy metals, cyanide, formaldehyde, and nicotine. In adults, exposure to ETS increases the risk of lung cancer, ischemic heart disease, and asthma. In children and fetuses, exposure to ETS is causally associated with a wide range of developmental and respiratory effects, including low birthweight, sudden infant death syndrome, lower respiratory tract infections, middle ear infections, symptoms of upper respiratory tract irritation, slight reductions in lung function, asthma, lifelong cardiovascular effects, type 2 diabetes, and obesity⁽²⁾. The International Agency for Research on Cancer (IARC) has classified ETS as carcinogenic to humans. There is sufficient evidence that ETS causes lung cancer and suggestive evidence that ETS may increase the risk of breast cancer, nasal sinus cavity cancer, and nasopharyngeal cancer in adults; and the risk of leukemia, lymphoma, and brain tumors in children⁽¹⁰⁾.

Policy and Regulations

Smoking is prohibited in Israel in most closed public places, including hospitals, trains and buses, restaurants, pubs, places of worship, and all government buildings, as well as in some open spaces, including swimming pools, railway platforms, and 75% of outdoor areas in pubs, restaurants, and wedding halls. New regulations from 2014 stipulate that smoking in sports stadiums is restricted to designated areas of no more than a third of the entire seating area. As of February 2016, all schools, universities, and student dormitories are required to be entirely smoke-free, including the perimeters of schools.

There are significant gaps in regulations to reduce public exposure to ETS. Pubs are allowed to set aside a quarter of their space for smokers, as long as it is in a separate room. Smoking is permitted in most private offices and non-governmental buildings, as well as in open and semi-open public spaces, such as gardens, museums, and zoos. Designated smoking areas are still permitted in universities, train stations, and other public places such as banks, post offices, and the Israeli parliament. The prohibitions on smoking in public places do not apply to new tobacco products, such as electronic cigarettes. Proposed legislation restricting smoking in playgrounds and in cars in the presence of children under the age of 16 was not approved by the Ministerial Committee on Legislation. The Ministry of Health (MoH) is currently developing legislation to restrict smoking in playgrounds, outdoor areas of cafés, and zoos, and to extend the restrictions on advertising and smoking in public places to electronic cigarettes.

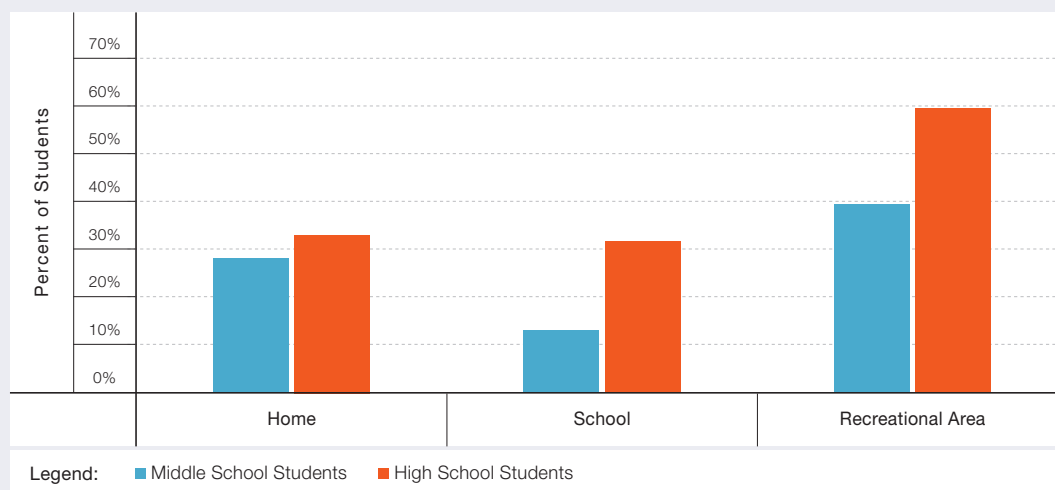
Data on Exposure to Environmental Tobacco Smoke in Israel

Despite extensive legislation to prevent exposure of the non-smoking population to ETS, data from surveys show that most of the Israeli population is exposed to ETS. In a national survey of students in 2015-2016 (National Health and Nutrition Survey in Adolescents, Young MABAT), over 50% of high school students reported that others smoke near them in recreational areas, and over 30% reported that others smoke near them in school (Figure 1)⁽⁶⁾.

In an effort to assess ETS exposure, data from questionnaires and urine samples were collected in the 2015-2016 National Health and Nutrition Survey (Rav-MABAT), which included 100 children ages 2-12, but results have not yet been published. According to MoH data published in 2014, 25% of Jewish infants and 52% of Arab infants are exposed to ETS at two months of age, probably by parents and relatives who smoke.

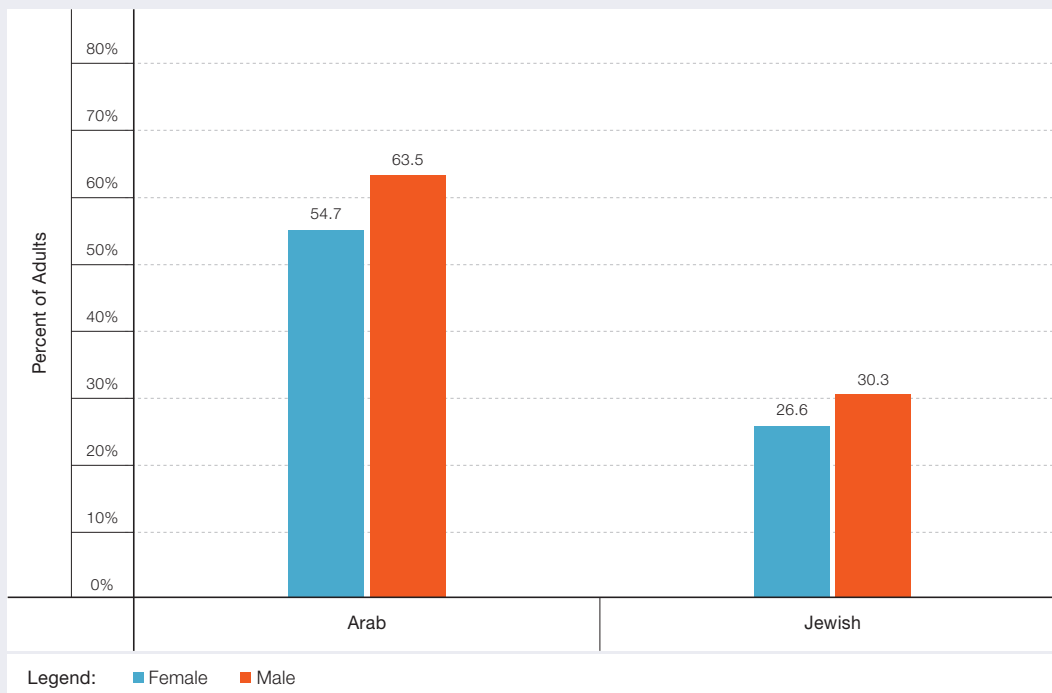
Primary Locations in which Students are Exposed to Environmental Tobacco Smoke, 2015 - 2016

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Figure 1
 Source:
 Israel Ministry
 of Health⁽⁶⁾



In the 2013-2015 Israeli National Health Interview Survey (INHIS-3), 37% of non-smokers reported exposure to ETS at least once or twice a week. ETS exposure was twice as high among the Arab population, and was higher among men (Figure 2) - over 45% of males reported exposure to ETS at their workplace. Among both Jewish and Arab women, reported exposure to ETS was higher at home than at other locations. Over 70% of Arab women reported exposure to ETS at home⁽⁵⁾.

Percent of Adult Non-Smokers Reporting Exposure to ETS, Israel National Health Interview Survey (INHIS-3), 2013-2015



←
Figure 2
 Source:
 Israel Ministry of
 Health⁽⁶⁾

In addition to data from national surveys, there is sporadic data on the exposure of several populations to ETS. Self-reported exposure to ETS among non-smoking Arab women was high among women with acute coronary heart disease (92%) and in the control group (53%)⁽¹⁾. In a survey of medical, dental, and pharmacy students, and employees of the School of Pharmacy at the Hebrew University Hadassah Medical School at the Ein Kerem campus in Jerusalem, 60.2% of non-smokers reported exposure to a smoky environment at least once a week⁽³⁾.

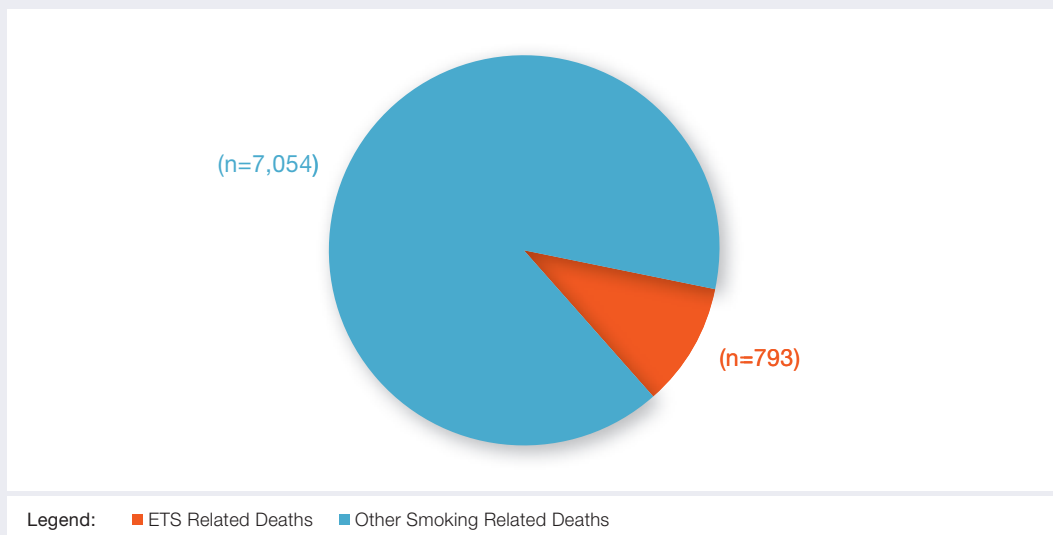
Data on Health Effects of Exposure to Environmental Tobacco Smoke in Israel

The health effects of exposure to ETS in 2014 include an estimated 793 deaths and 36,049 attributable hospital days (Figure 3). This accounted for approximately 10% of total smoking attributable deaths and 10% of total smoking attributable hospital days⁽⁴⁾.

Smoking Attributable Deaths in Israel, 2014

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Figure 3

Source:
Ginsberg et al., 2014⁽⁴⁾



Research on Exposure to ETS in Israel

- Researchers at the MoH and the Hebrew University-Hadassah Braun School of Public Health and Community Medicine reported that exposure to polycyclic aromatic hydrocarbons (PAHs) was high among non-smokers exposed to ETS⁽⁹⁾.
- Researchers from Tel Aviv University are currently conducting research on the use of measures of tobacco smoke in air and nicotine in children’s hair to persuade parents to adopt smoke-free homes and thus reduce the harm to children from tobacco smoke in the home. A study based on in-depth interviews with parents of young children in families of smokers in central Israel showed that non-invasive biomarker testing of children was acceptable from the parents’ perspective, and that such testing is a promising tool for educating, counseling, and motivating parents to protect their children from ETS⁽¹¹⁾.
- Urine samples were collected from 100 children and 200 adults who participated in the 2015-2016 National Health and Nutrition Survey (Rav-MABAT), and an analysis of the urinary cotinine levels of the samples is underway. Estimates of exposure to ETS based on urinary cotinine measurements will be compared to estimates of self-reported exposure to ETS, based on the data collected in a questionnaire as part of the survey.
- Researchers from the Hebrew University-Hadassah Braun School of Public Health and Community Medicine and Assaf Harofeh Medical Center analyzed urinary cotinine levels in children treated in the emergency department in order to compare exposure to ETS in children with respiratory symptoms, to exposure in the control group. Preliminary results indicate exposure to ETS among most children in the study.

Progress Since 2014

In *Environmental Health in Israel 2014*, the major challenges to the reduction of public exposure to ETS in Israel included enforcement of legislation prohibiting smoking in public places and protection of children from exposure to ETS in schools. Additional challenges included the need to minimize gaps in national data on the prevalence of asthma in children, and in biomonitoring data on exposure to ETS.

Significant progress has been made in protecting children from exposure to ETS in schools. Since February 2016, schools are required to be smoke-free. Some progress has been made in collecting national data on the prevalence of asthma and in collecting human biomonitoring data. Analysis of urinary cotinine levels in children is underway as part of the 2015-2016 National Health and Nutrition Survey (Rav-MABAT).

Some progress has been made toward developing analytical techniques to measure urinary cotinine levels at the Public Health Services Laboratory at the MoH. There has been little or no progress toward other goals.

Major Challenges

The most significant challenge in reducing public exposure to ETS in Israel is the fact that over 20% of the adult population smokes (22.7% according to the 2016-2017 Survey on Physical Activity Among Israeli Citizens)^(7,8). After decades of steady decline, smoking rates have increased among Jewish and Arab men since 2013. There is a critical need to shape social norms to deter smoking.

Enforcement of legislation prohibiting smoking in public places continues to be a major challenge. The prohibition of smoking on school grounds is not enforced and there is no legal requirement to place “No Smoking” signs in schools. The 2015 Ministry of Health Report on Smoking highlights the ongoing failure of local authorities to enforce the law prohibiting smoking in public places⁽⁷⁾. The MoH established a new department in 2013 to advance enforcement of anti-smoking laws by local authorities, to conduct inspections in public places, and to ensure that specific public complaints receive attention by the authorities. Local authorities are required to submit an annual report to the MoH on fines issued for smoking in public places, yet the vast majority of municipalities fail to do so.

In 2016, Israel Railways was required to pay NIS 6 million in a class action suit for failure to enforce the smoking ban on train platforms.

Despite legislation prohibiting smoking in public places, in the absence of enforcement by local authorities and in the absence of a change in social norms to discourage smoking, the majority of the public in Israel continues to be exposed to ETS.

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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 risk of cancer (for example, from exposure to trichloroethylene and trihalomethanes [THM]); adverse effects on neurodevelopment (for instance, from exposure to lead); and adverse effects on reproductive and birth outcomes (for example, from exposure to atrazine).

While in the past the focus on chemical parameters in drinking water was on the potentially toxic effects of contaminants, there is increasing evidence that certain parameters, such as minerals in drinking water, have beneficial effects on public health. There is evidence that low concentrations of magnesium in drinking water is related to an increased risk of cardiovascular disease, and that low calcium content of drinking water is associated with a higher risk of fracture in children, certain neurodegenerative diseases, preterm birth and low birth weight, and some types of cancer⁽⁸⁾. It is important to note that excess concentrations of minerals in drinking water may also cause adverse health effects.

Israel's drinking water is unique in that there is a high proportion of desalinated water in the distribution system (over 50%). Desalinated water has been used to supplement severely limited natural sources and to help cope with consecutive drought years. The distribution system includes water from different sources (desalinated, surface, and groundwater), and the mix can fluctuate hourly and monthly. This operational flexibility and the use of a range of drinking water sources allow for a reliable supply system. There is significant geographic variability in the water supply, including in the proportion of desalinated water in the supply system.

Policy and Regulations

Contaminants

The chemical quality of drinking water in Israel is regulated according to standards originally promulgated in 1974 and updated in 2013. The 2013 standards include maximum contaminant levels for over 90 chemical contaminants, including metals, pesticides, radionuclides, and industrial organic pollutants. Drinking water suppliers are required to conduct periodic testing for these contaminants in drinking water sources and to report the results to the Ministry of Health (MoH). Table 1 shows maximum permitted concentrations and potential health effects of selected contaminants highlighted in this chapter.

Potential Health Effects and Maximum Permitted Concentrations of Selected Contaminants in Drinking Water

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Table 1
 Source:
 United States
 Environmental
 Protection Agency⁽⁷⁾,
 Israel Ministry of Health

Contaminant	Maximum Permitted Concentration	Adverse Health Effects
Lead	10 µg/L	Developmental delays and neurocognitive effects in infants and children; effects on kidneys and blood pressure in adults; cardiovascular effects
Simazine	2 µg/L	Endocrine disruption
Atrazine	2 µg/L	Endocrine disruption
Trihalomethanes	100 µg/L (in 90% of samples) Maximum concentration for no more than two weeks is 150 µg/L	Disorders of liver, kidney, central nervous system; increased risk of cancer
Nitrates	70,000 µg/L	Shortness of breath and blue baby syndrome (methemoglobinemia) in infants
Trichloroethylene	20 µg/L	Disorders of kidney, liver and heart; increased risk of cancer
Tetrachloroethylene	10 µg/L	Disorders of kidney, liver and heart; increased risk of cancer

All products in contact with drinking water (pipes, faucets, fixtures, and household drinking water systems) must meet the requirements of Israeli Standard 5452. This standard was updated in 2016 to require that the lead content of products in contact with drinking water not exceed 0.25%. This requirement will enter into force for non-metal products in 2018 and for metal products in 2019.

Israel’s drinking water standards require testing for the presence of heavy metals (lead, iron, and copper) and disinfection by-products (THM, chlorite, and chlorate) in distribution systems. The frequency of testing depends on the drinking water source, disinfectant type, season, and population size of the community. The standards state that any individual can request the drinking water supplier to monitor the drinking water in his/her home in order to test for the presence of coliform bacteria, turbidity, lead, iron, and copper. The individual must cover the cost of the test, but the water supplier is required to conduct it and report the results.

The quality of bottled water, like other food products, is under the supervision of the National Food Service at the MoH. Standards set in 1986 define the maximum permissible concentrations of chemicals in the sources of bottled water.

Mineral Content

Israel's drinking water standards require large water suppliers that desalinate seawater to stabilize the water before it is supplied to the public. The required stabilization values include pH level of 7.5-8.3, dissolved calcium level of 80-120 mg/L as CaCO₃, alkalinity of above 80 mg/L as CaCO₃, Calcium Carbonate Precipitation Potential (CCPP) of 3-10 mg/L as CaCO₃, and a positive Langelier Saturation Index. Desalination plants established prior to 2009 are required to stabilize water according to a positive Langelier Index—without requirements regarding CCPP. In 2016, the MoH published less stringent requirements regarding levels of CaCO₃ (less than 3 mg/L).

While there is a requirement to add calcium to desalinated water, to date there is no requirement to also add magnesium, fluoride, or iodine. Drinking water fluoridation was discontinued in Israel in 2014. However, in 2016 the Knesset approved a change to the drinking water standards: the requirement of fluoridation at a concentration of 0.7 mg/L is planned to enter into force in 2017.

Data on Chemical Parameters in Drinking Water in Israel

Water Quality in Drinking Water Sources

The MoH publishes quarterly data on the microbial and chemical quality of water in drinking water sources based on data reported by drinking water suppliers. According to data reported for 2015-2016, four main chemical contaminants were detected in drinking water sources in Israel: atrazine (in 8.4% of the sources, concentrations between 0.08-0.67 µg/L), simazine (in 13.4% of the sources, concentrations between 0.08-0.52 µg/L), trichloroethylene (in 13.7% of the sources, concentrations between 0.1-101.6 µg/L), and tetrachloroethylene (in 10.3% of the sources, concentrations between 0.1-176.8 µg/L).

Heavy metals such as arsenic, mercury, lead, and cadmium occur naturally in the environment, and are detected in less than 10% of the drinking water sources, usually at levels below 30% of the maximum permitted concentrations in the drinking water standards. In 2014-2016, 890 drinking water wells were tested for the presence of lead and only 16 (1.8%) had detectable lead concentrations (all less than 5 µg/L).

Based on data from 1,250 samples collected in 2016, there are high concentrations of nitrates along the coastal aquifer. Twenty-six percent of the drinking water sources in central Israel, including Ashkelon, had nitrate levels between 50-70 mg/L, and an additional 17% had levels above the maximum permitted concentration in the drinking water standard (70 mg/L). Drinking water sources with nitrate concentrations above 70 mg/L are treated to reduce the concentration in

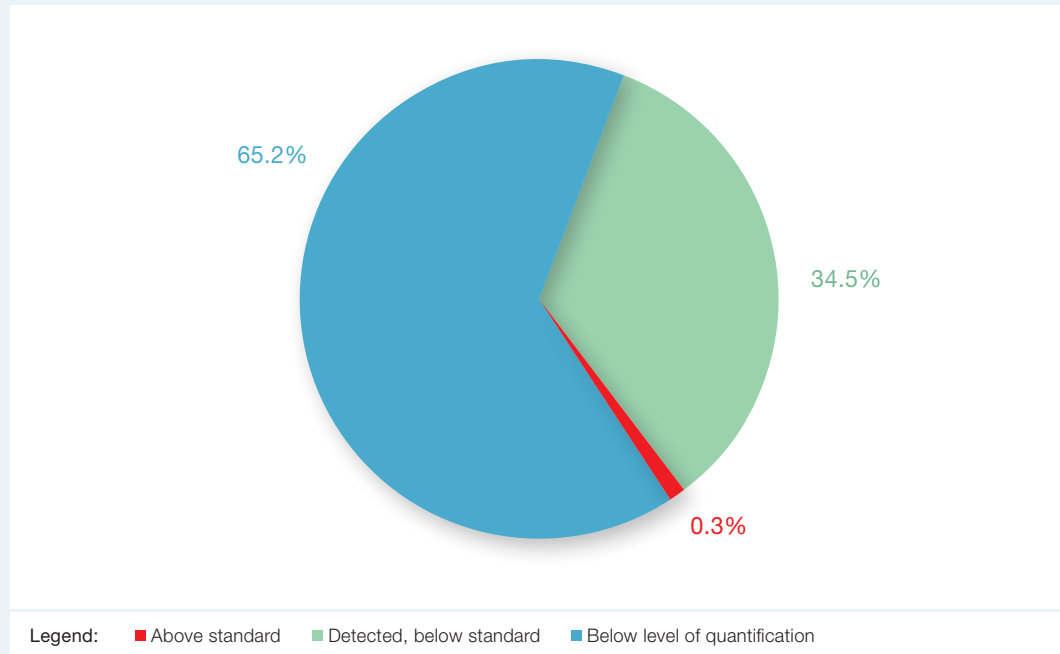
the supplied water. Nitrate concentrations were lower in the northern, southern, and Jerusalem districts. In the scientific literature, high nitrate levels in drinking water have been associated with methemoglobinemia. Therefore, the MoH assessed the methemoglobinemia rates in infants in 2011-2015 and examined the potential association with nitrate concentrations in drinking water. The analysis revealed that methemoglobinemia is rare in Israel and that there is no indication of an association between its incidence and nitrate concentrations in drinking water.

Water Quality in Municipal Water Distribution Systems

The MoH publishes data on water quality in municipal water supply systems, including data on concentrations of heavy metals and chlorination byproducts (THM). Data from 2014-2016 show that lead was detected in 35% of the samples, at concentrations below the standard of 10 µg/L. Lead concentrations exceeded the standard in 0.3% of the samples (Figure 1)⁽²⁾.

Lead Concentrations in Drinking Water in Municipal Supply Systems, 2014-2016 (n = 5,178)

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Figure 1
Source:
Israel Ministry
of Health⁽²⁾

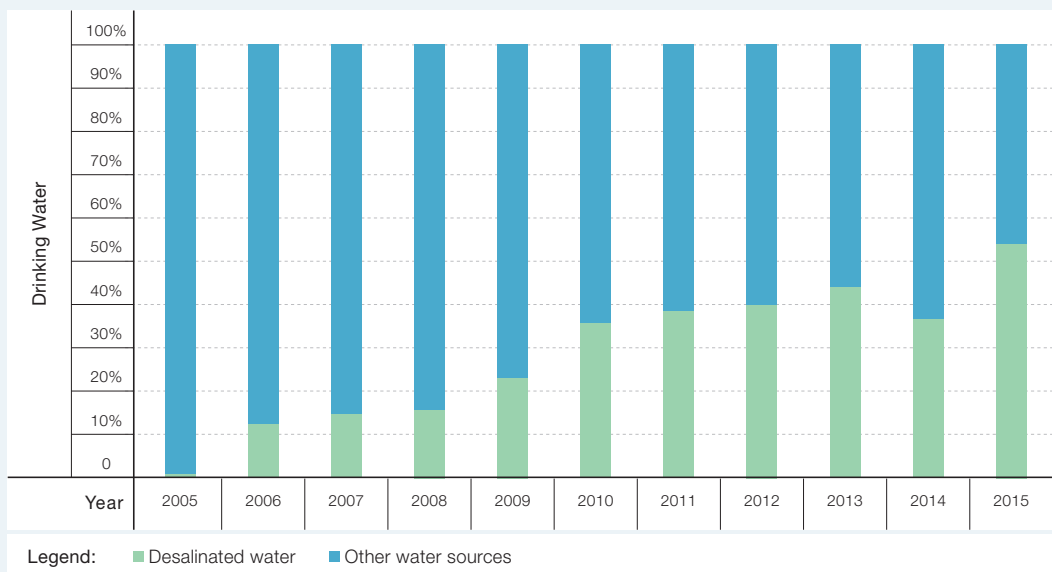


In 2015, there were sporadic exceedances in THM levels in communities in northern Israel receiving drinking water from the National Water Carrier. THM levels decreased significantly in 2016 following changes in the disinfectant and supply systems, the dilution of surface water with groundwater or desalinated water, and the aeration of water reservoirs.

Mineral Content

Israel’s drinking water supply is highly variable, consisting of desalinated water, surface water, and groundwater. The percentage of desalinated water of the total supplied drinking water has increased drastically from only 2.5% in 2005 to over 50% in 2015 (Figure 2).

Percentage of Desalinated Water out of the Total Drinking Water for Residential and Industrial Uses, 2005-2015



← Figure 2
Source: Israel Water Authority

Geographical differences in primary drinking water sources in Israel result in geographic variations in mineral content. Monitoring data from 2015-2016 indicate that the magnesium levels in drinking water sources were 150-190 mg/L in the south (Arava), 3-5 mg/L in the north, and 0 (zero) in desalinated water (compared with the recommended level of 20-30 mg/L). Iodine levels also vary considerably, ranging from 0 (zero) in desalinated water to 250 µg/L in the south (Arava) (Table 2). However, these values do not reflect the magnesium and iodine levels in the water supply system. For example, the general population in the Arava receives desalinated drinking water and not groundwater⁽¹⁾.

Iodine Concentrations in Drinking Water Sources (µg/L), 2016 (n = 260)

North	East Center	West Center	Southwest	Southeast (Arava)	Desalination Plants
2-3	5.5-25	7-95	18-150	250	0

← Table 2
Source: Israel Ministry of Health⁽¹⁾

Research on Adverse Health Effects and Drinking Water in Israel

- ♦ Researchers from Bar-Ilan University and the Sheba Medical Center compared 30-day and one-year mortality of acute myocardial infarction patients who participated in the biannual Acute Coronary Syndrome Israeli Survey during 2002-2013. Researchers found higher 30-day and one-year all-cause mortality in acute myocardial infarction patients in regions with desalinated water consumption, possibly attributable to reduced magnesium intake⁽⁶⁾.

- ♦ Researchers from the Hebrew University of Jerusalem assessed the relationship between iodine intake and thyroid function in a convenience sample of volunteers between 2012 and 2014, and found evidence of prevalent iodine-deficiency disorders in areas reliant on desalination^(4,5).
- ♦ In 2016, researchers from the Hebrew University of Jerusalem, Ben-Gurion University, and Maccabi Healthcare Services examined iodine levels in a representative national sample of school-age children and of pregnant women. The researchers found that 62% of school-age children and 85% of pregnant women had iodine deficiencies⁽³⁾.
- ♦ The MoH began a study in 2014 to assess the impact of the discontinuation of drinking water fluoridation on dental health in 12-year-old children in several areas in southern Israel.

Progress Since 2014

In the *Environmental Health in Israel 2014* report, the major challenges concerning chemical parameters in drinking water included understanding the potential impact of desalination on mineral intake and public health, understanding the impact of discontinuing fluoridation, and limiting the lead content of materials that come into contact with drinking water. Additional challenges were related to the presence of pesticides in drinking water sources and the lack of a central database of drinking water contaminants that are not included in the standards (such as unregulated chlorination byproducts and pharmaceuticals).

While progress has been made in researching the impact of magnesium and iodine deficiencies due to the consumption of desalinated water, the findings on these adverse health effects have not been translated into policy. A government feasibility study on adding magnesium to desalinated water, mandated by the 2013 drinking water standards, has yet to be completed. The MoH, the Ministry of Agriculture and Rural Development (MoAg), the Water Authority, and the Ministry of Finance are planning a pilot study to examine the feasibility of adding magnesium to drinking water; the study will seek to identify the best technology and estimate the required budget. To date, there is no plan to supplement desalinated water with iodine due to the potential harm of high iodine intake. In light of new findings of the prevalence of iodine insufficiency among children and pregnant women, the MoH published recommendations to add iodine to table salt and to salt used in bread.

There has been significant progress in limiting the lead content of products that come into contact with drinking water (new requirements will enter into force for non-metal products in 2018 and for metal products in 2019). There has also been significant progress in creating a central database of chemicals in drinking water, including unregulated chemicals such as carbamazepine. There is a lack of data on the presence of other unregulated chemicals - for example, per- and polyfluoroalkyl substances (PFASs).

Drinking water fluoridation was discontinued in 2014 and the impact on dental health is unclear, especially among low socioeconomic groups.

Major Challenges

Israel's unique drinking water system, which is characterized by a high proportion of desalinated water and fluctuation among different water sources (desalinated water, groundwater, surface water), faces unique challenges.

Dramatic fluctuations in drinking water sources can lead to consumer complaints about the water's taste. The MoH published recommendations stating that fluctuations should be gradual and accompanied by testing for the presence of heavy metals, but the implementation of these recommendations remains a challenge.

Since heavy metal testing of tap water is not conducted routinely in residences or institutions in Israel, it is unknown whether the increasing amounts of desalinated water in distribution systems have caused leaching of lead and other heavy metals into tap water. In the last MoH survey on the presence of lead in tap water, conducted in 2011, lead was detected in 10% of the samples. The MoH is planning the fourth survey on lead in tap water in residences and institutions, including schools.

While there is abundant data on chemical parameters of drinking water sources and drinking water in the municipal supply system, there is insufficient data about the chemical quality of tap water. Mekorot, the national drinking water supplier, is planning to develop a model for assessing and managing the water mix at central mixing junctions and at points of consumption. This will help the MoH and researchers evaluate the mineral content - for example, iodine and magnesium - in drinking water.

The MoH aims to reinstate drinking water fluoridation in 2017, after having discontinued it for three years. Since the standards require that fluoride levels not exceed 0.7 mg/L, this will require precise monitoring of fluoride in the distribution system.

Israel is becoming increasingly reliant on desalinated water as its primary source of drinking water. In recent years, the Water Authority began planning an additional desalination plant in northern Israel to supply desalinated water to the Galilee region. There is a need for further research on the impact of desalination on the intake of magnesium, iodine, fluoride and other minerals, and the potential impact of decreased mineral intakes on public health. As the percentage of the population consuming desalinated drinking water continues to grow, there is an increasing need for ongoing discourse among policymakers on ways to minimize the potential public health risks associated with desalination and low mineral intake.

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Wastewater

The main potential risk to public health from the use of wastewater for agricultural irrigation is the transport of pathogens to crops through insufficiently treated wastewater. In light of the threat of antibiotic resistance to global health, there is increasing concern regarding the potential role of wastewater treatment plants in the spread of antibiotic resistant genes and bacteria. In addition, there is evidence that crops irrigated with treated wastewater may contain pharmaceuticals and other emerging contaminants of concern. It is still unknown whether exposure to very low levels of pharmaceuticals and other contaminants from consumption of crops irrigated with treated wastewater is associated with adverse health effects.

Israel is a world leader in the reuse of domestic wastewater: more than 80% of wastewater is reused and 50% of wastewater undergoes tertiary treatment (treatment that improves the quality of wastewater to a level that allows for unlimited irrigation)⁽⁸⁾.

Policy and Regulations

Current regulations for wastewater quality address the potential public health risk due to pathogen transport, as well as the potential public health and agricultural risks due to the presence of metals in wastewater. The Ministry of Health (MoH) and the Ministry of Environmental Protection (MoEP) are jointly responsible for setting standards for the quality of water used for irrigation. The standards define two types of wastewater used for irrigation:

- Wastewater following secondary treatment, which is used for industrial crops (e.g., cotton and fodder), crops that are dried in the sun for at least 60 days (e.g., corn and wheat), and fruit trees. There are no limitations on the bacterial concentrations in secondary treatment wastewater⁽⁵⁾.

- ♦ Wastewater following tertiary treatment, which can be used for unlimited irrigation of edible crops. Tertiary wastewater may contain up to 10 fecal coliforms in 100ml effluent. There are also maximum permitted concentrations of chemicals such as nitrogen (up to 35 mg/L) and sodium (200 ppm); and of metals such as mercury (0.005 mg/L), lead (0.25 mg/L), arsenic (0.25 mg/L), and cadmium (0.025 mg/L)⁽⁴⁾.

Current policy requires separating the treated wastewater used for irrigation from the irrigated crop. This includes, for example, defining a minimum distance between the effluent and the fruit through drip irrigation, and limitations regarding the time intervals between irrigation and harvesting (drying in the sun for 60 days helps reduce the pathogen load). The specific requirements also depend on the irrigated crop - for example, there are fewer restrictions on wastewater irrigation for produce eaten dried (such as wheat) or produce with a non-edible peel (such as bananas) than for produce eaten fresh with its peel (such as tomatoes)⁽⁵⁾.

In Israel, there are currently no regulatory requirements concerning the presence of pharmaceuticals and other contaminants in treated wastewater for crop irrigation. Based on requirements being developed by the MoH, in collaboration with the MoEP and the Water Authority, factories that produce or develop pharmaceuticals must submit a list of all pharmaceuticals and chemicals that are used or produced in the factory so that testing requirements can be designed for each facility. Issuance of the business license for the facility will be contingent upon testing and reporting.

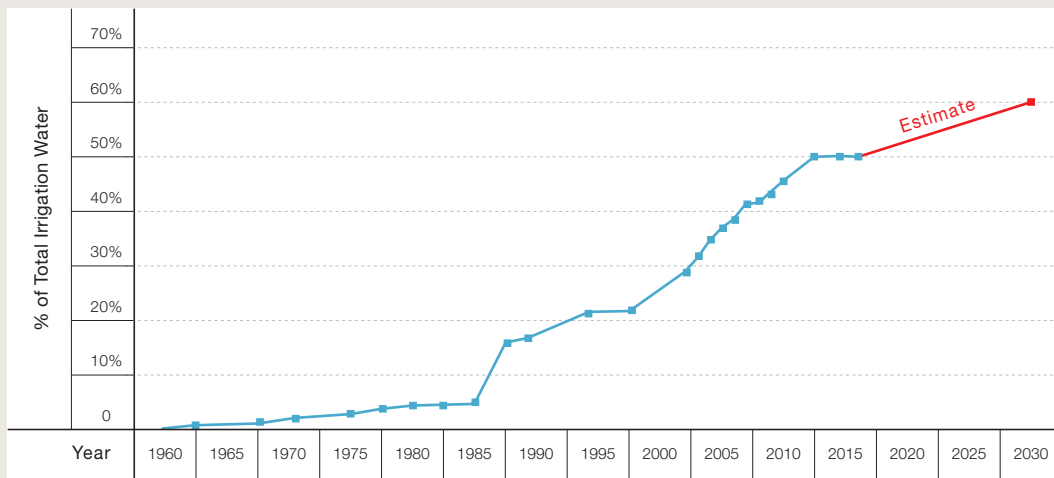
MoEP regulations from 2004 require that sewage sludge from wastewater treatment plants undergo efficient treatment. As of June 2017, the Shafdan Wastewater Treatment Plant (WWTP) is prohibited from disposing sewage sludge into the Mediterranean Sea.

To date, there is no national policy or program to collect household medical waste (including pharmaceuticals) in Israel. An analysis published by the MoH in 2016 indicates that policies for collecting household medical waste exist in many developed countries worldwide. According to data from the Central Bureau of Statistics, only 14% of the public in Israel return household medical waste to pharmacies; most of the public reports tossing unused pharmaceuticals into the trash or toilet at home, which increases the risk that pharmaceuticals will reach wastewater^(1,6).

Data on the Use of Treated Wastewater for Irrigation and on Chemicals in Treated Wastewater in Israel

Globally, Israel leads in the reuse of domestic wastewater: more than 80% of wastewater in Israel is reused, compared with less than 10% in the United States. Israel also leads in the use of treated wastewater for agriculture. Currently, 50% of the water used for agricultural irrigation is reclaimed wastewater⁽⁸⁾. This percentage is expected to increase to 60% by 2030 (Figure 1). Israel produces 530 million cubic meters of wastewater every year, most of which is used for agriculture.

Irrigation with Treated Wastewater in Israel (Percent of Total Water Used for Irrigation), 1960-2030

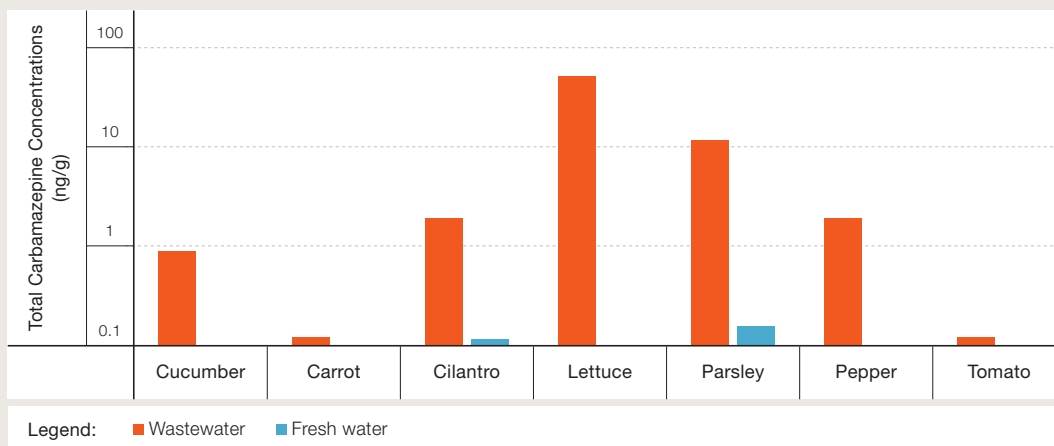


←
Figure 1
Source:
Israel Water
Authority⁽⁷⁾

Research on Chemicals in Wastewater and on Crops Irrigated with Treated Wastewater

Researchers from the Hebrew University's Center of Excellence in Agriculture and Environmental Health quantified the uptake of pharmaceutical compounds by carrots and sweet potatoes irrigated with treated wastewater and grown in controlled conditions. In both crops, the researchers found traces of the anti-epileptic drugs carbamazepine (CBZ) and lamotrigine, and of caffeine, with higher levels in the leaves than in the roots⁽⁹⁾. This team of researchers also found that CBZ levels were significantly higher in vegetables irrigated with treated wastewater, compared with those irrigated with freshwater (Figure 2)⁽¹⁰⁾.

Concentrations of CBZ and its Metabolites in Agricultural Crops Irrigated with Treated Wastewater versus Freshwater

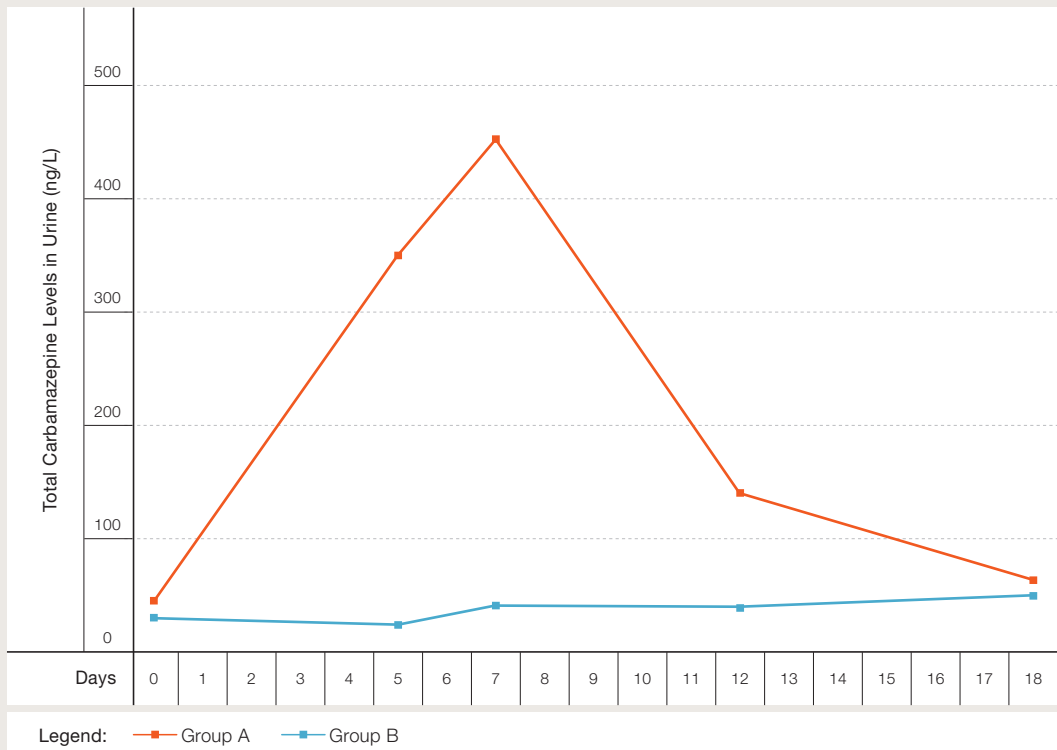


←
Figure 2
Source:
Paltiel et al., 2016⁽¹⁰⁾

Using a new analytical technique to quantify traces of CBZ and its metabolites in urine, the same team of researchers showed that individuals consuming treated wastewater-irrigated produce excreted CBZ and its metabolites in their urine, while subjects consuming freshwater-irrigated produce excreted undetectable or significantly lower levels of CBZ and its metabolites. The researchers quantified CBZ and its metabolite levels in two groups: Group A received produce irrigated with treated wastewater, and seven days later received freshwater-irrigated produce; Group B received freshwater-irrigated produce and seven days later received produce purchased from a local supermarket; the irrigation sources for the latter were unknown but probably included treated wastewater. The levels of CBZ and its metabolites measured in Group A after consuming the treated wastewater-irrigated produce were high, but these levels significantly decreased after consuming freshwater-irrigated produce. On the other hand, in the control group (Group B), the levels of CBZ and its metabolites were stable (Figure 3)⁽¹⁰⁾.

Concentrations of CBZ and its Metabolites (ng/L) in Urine of Volunteers who Consumed Treated Wastewater-Irrigated Produce Followed by Freshwater-Irrigated Produce (Group A) Versus Concentrations in Urine of Volunteers who Consumed Freshwater-Irrigated Produce Followed by Produce Irrigated from an Unknown Source (Group B)

→
Figure 3
Source:
Paltiel et al., 2016⁽¹⁰⁾



This team of researchers is now extending the study to examine CBZ levels in urine of healthy Israelis consuming their usual diet, in order to assess CBZ exposure in sub-populations including children, vegetarians, pregnant women, and the elderly.

Researchers at Ben-Gurion University (BGU) and the MoH analyzed the impact of wastewater and floods on water quality and the health of fish in a water reservoir. The researchers examined the levels of nutrients and organic micro-pollutants (OMPs) during 2013-2014 in the Yeruham Lake, and the OMP levels in sediment and fish tissues. The researchers found low concentrations of four OMPs (estrone, CBZ, diclofenac, and bezafibrate) in the lake. Polychlorinated biphenyls (PCBs) and dioxins were found in fish muscle and liver at very low concentrations. Histopathological analysis of the fish in the lake showed they were healthy⁽¹²⁾.

A joint study by Israeli researchers from BGU and the MoH, and Palestinian researchers from the Water and Environmental Development Organization (WEDO) and the Water and Soil Environmental Research Unit (WSERU) at Bethlehem University examined the presence of endocrine-disrupting chemicals (EDCs) in Israeli and Palestinian wastewater treatment plants. It should be noted that only secondary treatment is performed at wastewater treatment plants in the Palestinian Authority. The researchers analyzed wastewater, treated wastewater, and sludge in six wastewater treatment plants in Israel and in Palestinian plants. Lower concentrations of bisphenol A (BPA), octylphenol, and triclosan were found in the wastewater in the Palestinian wastewater treatment plants. However, hormone concentrations in wastewater were higher in the Palestinian Authority than in Israel. Removal efficiency in all advanced wastewater treatment plants was high in comparison with averages reported in the world⁽²⁾.

Researchers from the MoH and the Agricultural Research Organization's Volcani Center are participating in research projects funded by the European Union: the ANSWER (ANTibioticS and mobile resistance elements in WastEwater Reuse applications) project and the NEREUS (New and Emerging Challenges and Opportunities in Wastewater Reuse) project⁽³⁾.

Progress and Challenges

There has been progress in advancing policy to reduce discharge of pharmaceuticals from pharmaceutical factories into sewage. In addition, the MoH is making efforts to raise public awareness regarding safe disposal of household medical waste⁽⁶⁾.

Researchers in Israel have made significant progress in recent years in studying the potential exposure of the population to pharmaceuticals and other contaminants via crops irrigated with treated wastewater, and in understanding the role of wastewater treatment plants in the dissemination of antibiotic-resistant genes. The participation of Israeli researchers in several EU-funded projects, including a survey of antibiotic-resistant bacteria in 30 wastewater treatment plants worldwide, is noteworthy.

There is a need for further research on these emerging issues and a need for continued collaboration and communication between researchers and policy makers.

In 2016, two seminars were conducted with the participation of experts from academia and government officials:

1. An expert consultation on resistance to antibiotics in wastewater included experts from academia, MoH, MoEP, Ministry of Agriculture and Rural Development (MoAg), industry, and additional consultants. The experts concluded that although wastewater may contain antibiotic-resistant bacteria and genes for antibiotic resistance, the current levels of knowledge, science, and experience are insufficient to determine whether antibiotic-resistant bacteria and genes for resistance found in wastewater pose a health risk. The experts recommended:
 - (a) "Waste minimization" - decreasing the use of antibiotics by the public and in livestock; and
 - (b) Conducting additional research, monitoring, and data collection on resistant bacteria, and antibiotic resistant genes in sewage, wastewater, fields, and agricultural crops, as well as in the population and in hospitals⁽¹¹⁾.
2. A seminar on micro-pollutants in wastewater and sludge included experts from academia and government (MoH, MoEP, MoAg and the Water Authority). The participants decided to assess the existing knowledge in this field in Israel and in the world in order to re-evaluate policy in this field.

Additional challenges

- ♦ Risk assessments need to be performed on the effects of chemical contaminants in treated wastewater, with emphasis on humans, farm animals, and their products (eggs, milk and meat).
- ♦ An integrated database should be created that includes chemical and microbiological monitoring of sewage originating in households, hospitals, farms, and the pharmaceuticals and chemical industries; monitoring wastewater treatment plants (before and after treatment); antibiotic resistance in wastewater, soil, plants and crops; and data on specific types of resistant microbes found in hospitals and farms.
- ♦ Additional research is needed on more efficient technologies for coping with micro-pollutants and antibiotic resistance in wastewater.

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Pesticides

Pesticides are mixtures of substances used in agriculture and in urban environments to protect plants and animals from pests and diseases, to control weeds, and to protect humans from vector-borne diseases. Acute occupational or accidental exposure to high doses of certain pesticides can cause adverse health effects, including neurological disorders and death. Low-level chronic exposure to pesticides has been associated with neurological, respiratory, reproductive, and endocrine effects, as well as cancer. Evidence from toxicology and epidemiology indicates that fetuses, infants, and children are uniquely vulnerable to the effects of pesticides.

New classes of biological pesticides (containing bacteria, fungi, and viruses) as well as chemical pesticides (e.g., pyrethroids and neonicotinoids) are increasingly replacing more toxic classes (e.g., carbamates and organophosphates [OPs]). However, there is emerging evidence regarding the toxicity of these new classes of chemical pesticides⁽⁶⁾.

Highly toxic pesticides, such as phosphine, chlorpyrifos, formaldehyde, and metam sodium, continue to be used worldwide and in Israel.

Policy and Regulations

Pesticide Registration

Four government authorities are responsible for registering pesticides in Israel:

1. The Plant Protection and Inspection Services (PPIS) unit at the Ministry of Agriculture and Rural Development (MoAg) is responsible for registering pesticides for plant protection. There are approximately 1,200 conventional pesticide formulations—in addition to 200 pesticide formulations for organic agriculture – based on 300 active ingredients registered by the PPIS. Conditions for pesticide registration and label requirements are specified in standards passed in 1994, which are currently under review.

2. The Veterinary Services unit at the MoAg is responsible for registering pesticides and disinfectants for use on animals and in farm buildings. There are approximately 150 pesticide and disinfectant formulations based on 30 active ingredients registered by the Veterinary Services. In 2016, the MoAg updated the standards requiring the registration of all veterinary pesticides and disinfectants marketed in Israel.
3. The Ministry of Environmental Protection (MoEP) is responsible for registering pesticides used for sanitation purposes, i.e., for mosquito, rodent, and other pest control in and around residences and buildings, and in open spaces. There are approximately 200 formulations based on 50 active ingredients registered by the MoEP. Conditions for registration and label requirements are specified in standards passed in 1994, which are based on the Toxic Substances Law.
4. The Ministry of Health (MoH) is responsible for registering pesticides that are applied on the human body (for example, for lice treatment or mosquito repellent for topical use).

The PPIS and Veterinary Services at the MoAg, and the MoEP have established inter-ministerial committees that include representatives from the MoH, the MoAg, the MoEP, and the Ministry of Labor, Social Affairs and Social Services (MoLSA). These committees evaluate the risks of new pesticide formulations, including imported pesticides. The MoEP and the Veterinary Services, but not the PPIS, require that all pesticides be re-evaluated and approved by the inter-ministerial committees before renewal of their registration. In recent years, several active ingredients have been phased out, following recommendations by the inter-ministerial committees (Table 1). Pesticides banned in 2012-2014 are listed in the *Environmental Health in Israel 2014* report.

Phased-Out Pesticides in Israel, 2015-2016

→
Table 1
 Source:
 Israel Ministry for
 Environmental
 Protection,
 Israel Ministry of
 Agriculture and Rural
 Development

Active Ingredient	Responsible Government Entity	Use	Phase-Out Date
Propoxur	MoEP	Indoor spray	December 2016 (end of January 2017 for professional use)
Propoxur	Veterinary Services	Pet collars	April 2016
Chlorpyrifos	Veterinary Services	Spray for sheep	December 2016
Pirimiphos-methyl	MoEP	Outdoor spray (mosquito control)	December 2015
Temephos	MoEP	Outdoor spray (mosquito control)	December 2015
Carbaryl	Veterinary Services	Spray/powder for sheep	June 2016
Carbaryl	PPIS	Crop spray	April 2015
Benfuracarb	PPIS	Crop spray	April 2015
Carbosulfan	PPIS	Crop spray	April 2015
Flusilazole	PPIS	Crop spray	March 2015
Dicofol	PPIS	Crop spray	March 2015
Trifluralin	PPIS	Crop spray	December 2015

In addition to the registration and labeling approval of pesticide products, different government ministries are responsible for various regulations pertaining to pesticide use.

Pest Control Professionals

A new law regulating the practice of sanitary pest control came into effect in 2016. The law established four types of licenses for pest control professionals (domestic, structures and open spaces, fumigation, and military). Among its many new requirements, the law stipulates that pest control professionals must treat pest problems in a non-chemical manner when possible, before resorting to chemical pesticides.

Pesticide Drift

The MoEP and MoAg are jointly responsible for two standards that define minimum distances from structures that must be maintained when applying pesticides from the ground or the air. Both regulations are currently under revision.

Pesticide Residues

The MoH and the MoAg are jointly responsible for regulations establishing Maximum Residue Levels (MRLs) of pesticides in agricultural produce. Updated regulations came into force in 2016. Compared to the previous standards from 1991, 285 MRLs were cancelled in the 2016 standards, reflecting the phase-out of many OP pesticides in agriculture in Israel.

The Law for Inspection of Plant Production and Marketing, enacted in 2011, requires the MoAg to formulate standards to ensure the safety and quality of locally produced fruits and vegetables.

Proposed Legislation

Several draft laws and standards related to pesticide use have been developed and circulated in recent years. The MoLSA proposed regulations that would require all pesticide applicators to receive training and certification, and to undergo regular medical tests. The proposed regulations would also prohibit the sale of pesticides to uncertified individuals, with the exception of pesticides intended for use by the general public. The MoEP proposed updating standards with stricter requirements regarding pesticide application near structures. Finally, an environmental NGO, Adam Teva V'din (Israel Union for Environmental Defense), proposed a law that would regulate the use and sale of restricted use pesticides, establish minimum distances between the application of pesticides and structures, and require development of a pesticide use database. These proposed standards and laws are in different stages of the legislative process and have yet to be approved.

Data on Pesticide Use and Exposure in Israel

Sales

Data published in 2016 by the Central Bureau of Statistics indicate a 14% decrease in sales of agricultural pesticides in 2011-2013 relative to 2008-2010⁽⁴⁾. There was a sharp decrease in sales of soil fumigants (-35%) and an increase in sales of herbicides (3%). Soil fumigants and fungicides account for 26% and 35% of agricultural pesticide sales, respectively. There was also a 20% decrease in the amount of active ingredient sold per area of agricultural land in Israel (2.1% in

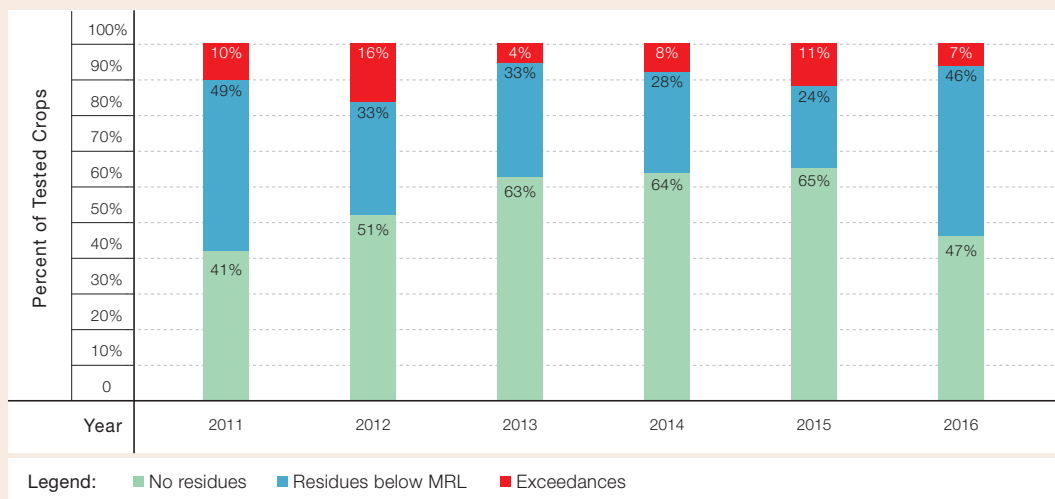
2013 compared to 2.6% in 2010). Despite this decrease, Israel continues to hold the record for the use of pesticides (tons per 1,000 m² of agricultural land) among selected Organization for Economic Cooperation and Development (OECD) countries. Sales of sanitation pesticides dropped by 20% between 2010 and 2013. There was an increase in the sales of pesticides for use by the general public compared to pesticides for professional use (48% in 2013, up from 34% in 2008).

Pesticide Residues

The MoH surveys pesticide residues in crop samples at the point of sale⁽⁵⁾. The survey strategy is based on the oversampling of products with high potential for pesticide residues. In 2016, the MoH tested pesticide residues in 920 crop samples. The primary active ingredients detected in crops were chlorpyrifos, methomyl, dimethomorph, dinotefuran, and imidacloprid.

Trends in Pesticide Residue Levels, Based on Ministry of Health Surveys, 2011-2016

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Figure 1
 Source:
 Israel Ministry
 of Health⁽⁵⁾



According to MoAg data published in 2017 on pesticide residues in crops sampled in the field in 2015 (n=642), 44% of tested crops had no residues, 44% had residues below the MRLs, and 12% had residues above the MRLs. It is important to note that 19% of tested apples and 24% of tested melons had exceedances above the MRLs⁽⁷⁾.

Incidents and Poisonings

The MoEP collects data on incidents involving the use of agricultural pesticides in and near residences. Between January 2015 and October 2016, there were 255 public complaints in agricultural areas, which included 128 reports of adverse health symptoms.

In addition, between January 2014 and December 2015, 26 incidents involving illegal residential use of agricultural pesticides were reported. Two children died in 2014 as the result of illegal use of phosphine for domestic pest control in a residential building in Jerusalem, and another incident involving the illegal use of phosphine in a residential building was reported in Herzliya in 2015. There were 12 incidents involving the illegal use of OP pesticides (chlorpyrifos and

diazinon) in residential areas. It is worth noting that chlorpyrifos and diazinon were phased out for residential use in 2008 and for use in public parks in 2009. Diazinon for plant protection uses was phased out in 2014 and the chlorpyrifos formulation for veterinary use that was involved in numerous incidents was phased out in 2016.

Data on pesticide poisoning in Israel is not collected systematically, but there are sporadic data from several sources. According to data collected by the Israel Poison Information Center at Rambam Health Care Campus, there were 1,932 poisonings in 2014; only 27 of them resulted from occupational exposure. Most moderate or severe poisonings were attributed to exposure to OPs or carbamates. The total number of OP and carbamate poisonings in 2014 was 194. According to MoH data on emergency room visits, there were 18 visits in 2015 related to exposure to pesticides, including seven cases involving children under the age of four. The data indicate an increase in OP pesticide poisonings in 2010-2015. These data are partial and reflect underreporting by physicians.

In May 2017, two children visited the emergency room following an incident in which their drinking water was contaminated with the fumigant metam sodium. Based on a preliminary investigation of the incident, a farmer using metam sodium contaminated the public drinking water system. Tap water in the affected area was prohibited for drinking, cooking, and washing for five days.

Data on Exposure to Pesticides

Researchers from Hebrew University's Center of Excellence in Agriculture and Environmental Health and the MoH found that children have higher exposure to many pesticides compared to the general population, and that children's exposure to ten pesticides exceeded the Acceptable Daily Intake - ADI (Table 2).

Pesticide Intake Among Children in Excess of the Acceptable Daily Intake (based on pesticide residue data, 2006-2010)

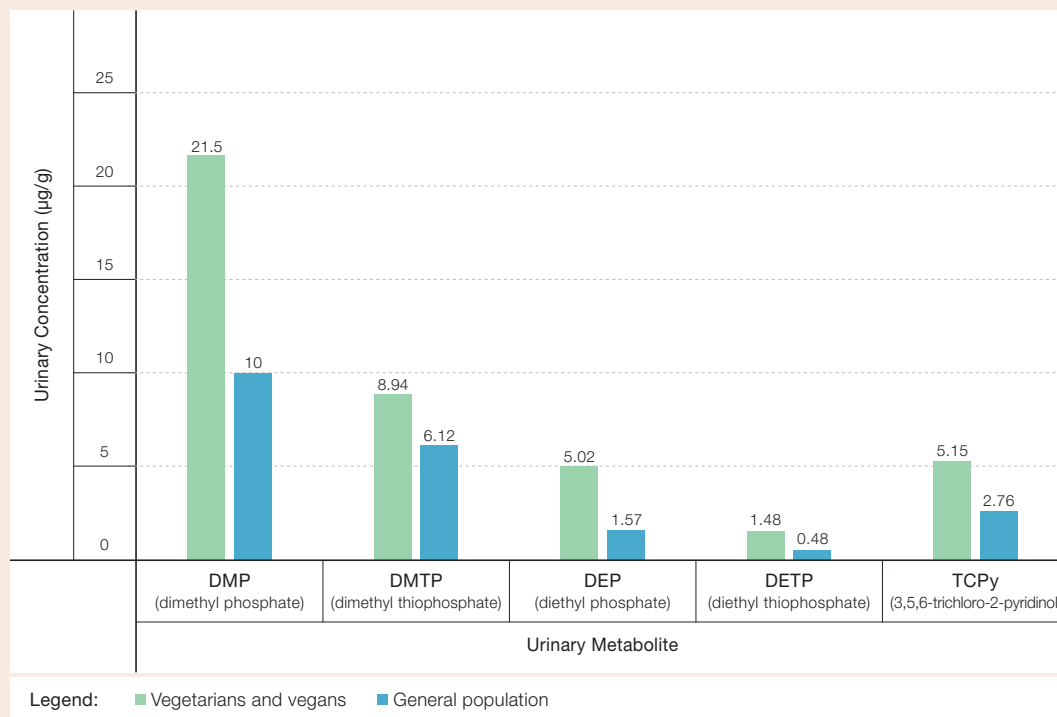
Active Ingredient	Exceedance of ADI, at Intake Percentile	Elevated Intake in Children Compared with the General Population	Use of Active Ingredient Restricted or Phased Out between 2012-2016
Cadusafos	75	+	Phased out
Carbosulfan	90		Phased out
Chlorothalonil	75		Neither phased out nor restricted
Chlorpyrifos	75		Restricted
Endosulfan	75		Phased out
Fenamiphos	50	+	Restricted
Iprodione	50		Neither phased out nor restricted
Methamidophos	25	+	Phased out
Monocrotophos	90	+	Neither phased out nor restricted
Oxydemeton-methyl	50	+	Phased out

←
Table 2
Source:
Freeman et al., 2016⁽³⁾

A pilot study by researchers from Tel Aviv Sourasky Medical Center and the MoH on exposure to pesticides in vegans and vegetarians in Israel indicated relatively high levels of urinary OP pesticide metabolite concentrations in residents of a vegetarian community in the Upper Galilee (Amirim) compared with the general population in Israel (Figure 2)⁽²⁾.

Urinary Creatinine-Adjusted Concentrations of Organophosphate Metabolites in Vegetarians and in the General Population

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Figure 2
 Source:
 Berman et al., 2016⁽²⁾



Research on Exposure to Pesticides in Israel

Researchers from Al Quds University in East Jerusalem, the Hebrew University of Jerusalem, and the MoH found that pregnant Palestinian women have lower exposure to OP pesticides compared to pregnant Jewish women in the Jerusalem region, possibly due to lower intake of fresh fruits and vegetables or less use of pesticides in the Palestinian population⁽¹⁾.

A study published in 2017 showed that secondary drift (i.e., post-application drift) of OPs can increase the potential exposure to chlorpyrifos⁽¹⁰⁾.

A study by researchers from Ben-Gurion University in 2015 found a higher incidence rate of Parkinson’s disease among Jewish populations living near large cultivated fields in the Negev, based on data collected between the years 2001–2012. The researchers found that the proximity to the field and its size were associated with the risk of this disease⁽⁹⁾.

Additional studies currently underway in Israel include: a birth cohort exploring exposure to OPs and adverse birth effects; a study on the impact of exposure to pesticides containing OPs, pyrethroids and triazines on male reproductive health; a biomonitoring study examining the exposure of Jewish and Arab school children in the Haifa Bay and in rural areas to OPs; and a study on air concentrations of pesticides in residential areas near agricultural fields. In addition, the MoH collected urine samples from 200 adults and 100 children (a subsample of participants in the National Health and Nutrition Survey 2015-2016 [Rav-MABAT]) in order to analyze OP metabolites in urine.

Progress Since 2014

In addressing the challenges raised in *Environmental Health in Israel 2014*, there has been little progress creating an integrated committee on pesticide registration, and pesticide registration continues to be based on recommendations from three separate committees. In addition, there has been little progress in establishing a comprehensive database on pesticide poisoning in Israel. There are studies underway measuring concentrations of pesticides in air near homes and schools, and urine samples from children and adults collected in 2015-2016 are being analyzed for the presence of OP metabolites. The MoAg published a list of inert ingredients prohibited in pesticide formulations.

Major Challenges

One of the major obstacles in promoting comprehensive pesticide policy in Israel is the overlap, and sometimes division, of areas of responsibility among numerous government bodies. This impedes the regulation of the sale of agricultural pesticides, the urban use of plant protection pesticides, the agricultural use of pesticides near schools; and updating of regulations aimed at reducing risk from pesticide drift. Phosphine, a fumigant that caused the death of two children in 2014, is still registered by both the MoEP and the MoAg for overlapping uses, without sufficient coordination or oversight. A number of different entities have proposed new legislation on pesticide use in Israel, but this might exacerbate the existing problem of division of responsibility. Uniform and comprehensive legislation on pesticide registration and use is required.

Another major obstacle is the lack of regulatory oversight on the sale and use of agricultural pesticides. In the field of sanitation pesticides, pesticide applicators receive training and certification, and certain formulations are registered and sold for professional use only. There is no regulatory framework for restricting the sale and use of high-risk plant protection products and veterinary preparations, and these products continue to be sold freely on the market. The high number of incidences of illegal residential use of agricultural pesticides is indicative of this problem. The 2017 State Comptroller Report highlights the fact that the MoAg does not supervise the proper use of agricultural pesticides. The report also notes that the MoAg reduced

the budget allocation for training farmers and for integrated pest management initiatives. According to the report, the MoLSA performs inspections of fewer than 1% of the workers using pesticides⁽⁸⁾.

To date, dietary risk assessments on exposure to pesticides are performed using data on market-based diets (the amount of food sold). Dietary data on children in Israel was collected in the National Health and Nutrition Survey in 2015-2016 (Rav-MABAT), but is not yet available for risk assessment. While studies on the dietary exposure of vegetarians and children to pesticides showed that there may be subgroups with high levels of exposure, risk assessment is still conducted using average estimates of exposure.

The advisory committee on plant protection pesticides evaluates active ingredients currently registered for plant protection on an ad hoc basis. As a result, there may be delays in re-evaluation and in decision-making regarding active ingredients that have been phased out in the EU or United States. The same advisory committee is developing a work plan for the periodic re-evaluation of all active ingredients registered for plant protection at the MoAg. This is a considerable challenge considering that there are over 300 active ingredients registered for crop protection.

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Chemical Food Contaminants

Chemical food contaminants are substances that have been unintentionally added to food. Some chemical food contaminants are formed naturally (for example mycotoxins), while others come from environmental contamination (for example heavy metals, dioxins, polychlorinated biphenyls [PCBs], radionuclides), or are created during food processing (for example acrylamide).

Exposure to chemical food contaminants is associated with a wide range of adverse health effects. For example, chronic exposure to mycotoxins may cause cancer, endocrine disruption, gastrointestinal disorders, and kidney function disorders. Exposure to polycyclic aromatic hydrocarbons (PAHs) may result in adverse effects on the liver, reproduction and development, and the immune system⁽¹⁾. Some PAHs are carcinogens - benzo[α]pyrene is classified as carcinogenic in humans (Group 1)⁽²⁾. Heavy metals, such as mercury, cadmium, arsenic, and lead, are associated with cognitive developmental delays in children and neurological impairment in adults, as well as with adverse effects on the immune and cardiovascular systems.

This chapter addresses chemical food contaminants. Chemicals in food linked with wastewater irrigation are addressed in the Wastewater chapter, pesticide residues are addressed in the Pesticides chapter, and food contact materials are addressed in the Chemicals in Consumer Products chapter.

Policy and Regulations

The new Public Health Protection (Food) Law, enacted in 2015, prohibits the production, import, or sale of food containing contaminants at levels exceeding the maximum levels (MLs) specified in the regulations. MLs are generally established to protect vulnerable populations, including children.

The National Food Service (NFS) at the Ministry of Health (MoH) regulates food contaminants, including mycotoxins, dioxins, PCBs, heavy metals (lead, cadmium, mercury, and arsenic) and PAHs⁽⁶⁾. In January 2017, the NFS updated the guidelines and defined the MLs of heavy metals. The new guidelines include a range of food categories and stricter MLs. The NFS also updated the guidelines for the MLs of PAHs and melamine in infant formula and in other food items, and published a new directive on the MLs of dioxins, furans, and PCBs. In addition, the standards related to mycotoxins are being updated. In 2016, the NFS published a consumer health advisory on arsenic in rice and in rice products with the recommendation that infants and pregnant women consume a variety of cereals and avoid consuming rice as the main cereal⁽⁷⁾.

The NFS has a number of routine monitoring programs, including the monitoring of pesticides and mycotoxins. It also conducts surveys as needed, based on assessments of existing and emerging hazards that might not be covered by routine monitoring - for example, mercury in fish, arsenic in rice and rice products, dioxins, furans, and PCBs in food of animal origin, and PAHs in smoked food.

The Veterinary Services unit at the Ministry of Agriculture and Rural Development (MoAg) conducts annual surveys on heavy metals, pesticides, pharmaceuticals, and other contaminants in food of animal origin, such as eggs, beef, turkey, and chicken.

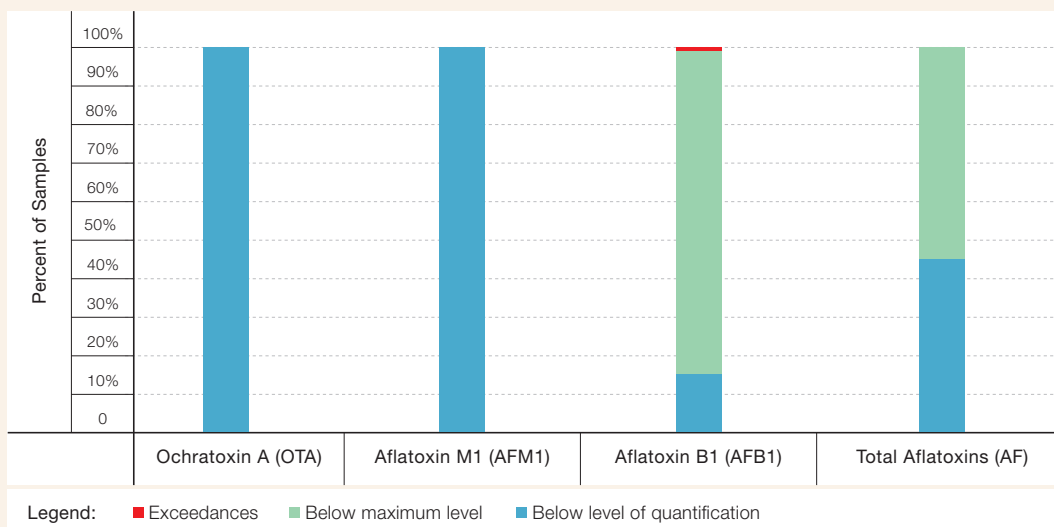
Data on Contaminants in Food in Israel

Mycotoxins

The NFS monitors mycotoxins in food products marketed in Israel. The monitoring is carried out according to an annual sampling plan that targets products known to be at high risk of containing mycotoxins such as corn, nuts, dried fruits, cereals, and dairy products.

In 2014, 535 food samples were collected and 925 tests were conducted to detect and quantify aflatoxins (types AFB1, AFM1, and total aflatoxins) and ochratoxin. Three out of the 535 samples (0.56%) exceeded the MLs⁽³⁾. In 2015, the NFS tested for the presence of mycotoxins in 470 samples (mostly nuts, spices, dry fruits, and milk). No mycotoxins were detected in 42% of the samples, and four (0.85%) samples had AFB1 levels above the MLs (Figure 1)⁽⁵⁾.

Distribution of Mycotoxin Monitoring Results in Israel, 2015



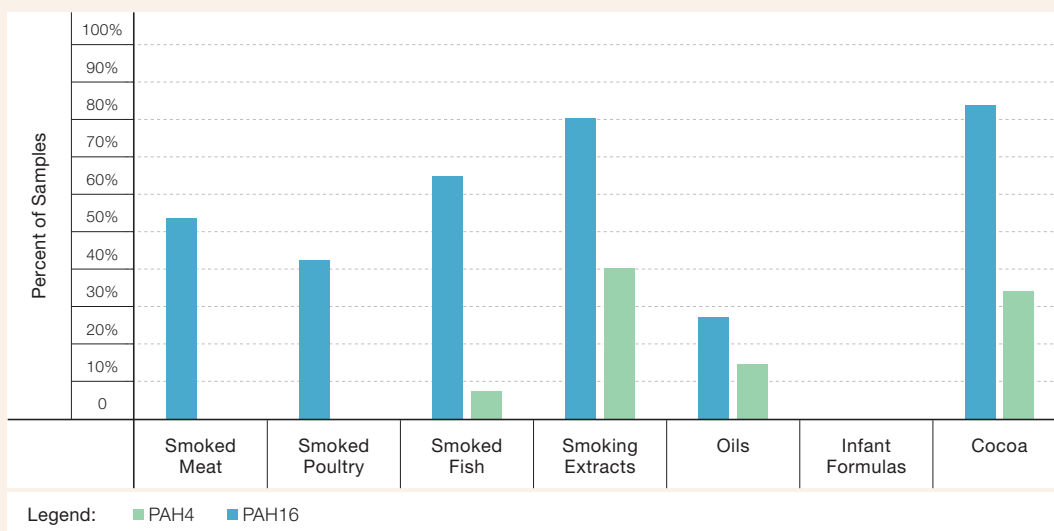
← **Figure 1**
Source: Israel Ministry of Health⁽⁵⁾

Polycyclic Aromatic Hydrocarbons (PAHs)

In 2015, the NFS tested 132 food samples for the presence of PAHs. These included smoked and other meat products, smoked fish, extracts used in the smoking process, cocoa products, infant formula, and vegetable oils. The full list of the 16 compounds tested is available in the MoH report⁽⁴⁾.

In 60 samples (45.45%), all 16 compounds (PAH16) were found to be below the level of detection (LOD). Figure 2 shows the percentage of samples with levels above the LOD for PAH4 (benzo[α]pyrene, benzo[b]fluoranthene, chrysene, benz[α]anthracene) and PAH16, according to food categories. Out of 132 food samples, only one product exceeded the ML for PAH4⁽⁴⁾.

Percent of Samples above the Level of Detection, by Food Categories in the National Food Service Survey, 2015



← **Figure 2**
Source: Israel Ministry of Health⁽⁴⁾

Based on these data, the NFS conducted a risk assessment to estimate exposure and risk for average and heavy consumers of the food categories sampled, using food consumption data from the National Health and Nutrition Surveys (MABAT). This assessment indicated that there is negligible concern for public health from exposure to PAHs from foods in the categories tested in this survey.

Heavy Metals

Data on concentrations of mercury in imported fish is collected regularly by the NFS. The NFS is also conducting a survey on arsenic in rice products, and the data will be published in 2017-2018.

Residues in Animal Products

The annual survey published by the MoAg's Veterinary Services and Animal Health Unit for 2014/2015 includes data on residues of heavy metals, pesticides, and pharmaceuticals in locally produced food of animal origin. Of the beef samples tested in 2015, none contained arsenic or lead. Organochlorine pesticides were detected in 10 beef samples (5.1%) at concentrations below the ML, and cadmium was detected in 6 beef samples (2.9%) at concentrations below the ML. Cadmium was detected in 170 turkey samples (76.2%) and in 21 chicken samples (7.5%); two of the turkey samples were above the ML. Organochlorine pesticides, PCBs, and heavy metals (other than cadmium) were not detected in turkey, chicken, or eggs⁽⁸⁾. After finding high dioxin levels in four samples of eggs in 2013, the NFS and the MoAg have continued analyzing dioxin levels in eggs. None of the eggs sampled in 2014-2016 had dioxin levels above the ML of 5 pg/g fat. It should be noted that the ML in Israel is based on the European ML for dioxins in eggs.

Progress Since 2014

In *Environmental Health in Israel 2014*, the major challenges concerning chemical food contaminants included conducting surveys on the presence of phthalates, aluminum, and PAHs, and evaluating the levels of heavy metals and radiation in crops treated with coal ash.

The results of the NFS survey on PAHs in food were published in 2017. The NFS collected over 100 food samples for a 2016 survey on the presence of aluminum. The results are still being analyzed, and the report summarizing the results is expected in early 2018.

Some progress has been made in evaluating the levels of heavy metals and radionuclides in crops treated with coal ash. Little progress has been made in conducting a survey on phthalates.

Major Challenges

Accurate exposure assessment is an integral part of risk assessment. In its risk assessment of PAHs, the NFS used food consumption data (as opposed to market-based data) for the first time to assess dietary exposure. Food consumption data from the National Health and Nutrition Survey

2015–2016 (Rav-MABAT), conducted among children and adults, is not yet available for use in risk assessment. The MoH plans to use data from this survey for exposure assessment, including for sub-populations. Creating a database of food consumption based on periodic National Health and Nutrition Surveys will enable more accurate exposure assessments for the general population and for sub-populations such as children, pregnant women, and vegetarians.

Public exposure to contaminants can be measured and quantified using a Total Diet Study (TDS). A TDS will enable a real assessment of the public's exposure to a wide range of contaminants via food, taking into consideration the effect of the preparation process on the type and level of contaminants in food. The establishment of a TDS in Israel will be an important element in the MoH's capacity to assess the public's dietary exposure to food contaminants. This includes contaminants not previously measured, such as flame retardants and phenols.

Data from the Israel Oceanographic and Limnological Research Institute indicate an increase in mercury concentrations in fish in the Acre Bay, apparently as the result of ongoing pollution from an abandoned plant on the shore. Due to the division of responsibility between the MoH and the MoAg, no ban has been imposed on fishing in the bay and a public advisory has yet to be issued.

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Chemicals in Consumer Products

Consumer products are potential sources of exposure to heavy metals, endocrine disrupting chemicals (EDCs), and volatile organic compounds (VOCs). High concentrations of heavy metals, including lead, mercury and arsenic have been detected in toys, paints, jewelry, and personal care products. Cases of acute lead poisoning have been reported following exposure to toys and paints containing high levels of lead.

There is increasing evidence that consumer products significantly contribute to cumulative exposure to EDCs such as phthalates, flame retardants, perfluorinated compounds, and triclosan, and that chronic exposure may be associated with adverse health effects. For example, triphenyl phosphate (TPHP), a commonly used organophosphate (OP) flame retardant in consumer products, has been associated with altered thyroid function. Perfluorinated compounds used in consumer products (for example, in water-repellant and stain-resistant coatings for textiles) have been associated with cancer, thyroid disruption, immune system impairment, and reduced human fertility. Paints, polyvinyl chloride (PVC), and wood products can emit VOCs, including formaldehyde. Exposure to these consumer products has been associated with increased risk of allergic reactions and respiratory difficulties in children.

Policy and Regulations

Unlike the United States and Europe, there is no comprehensive regulatory framework for consumer products in Israel. There is also no regulatory framework for the systematic review and registration of chemicals in consumer products in Israel⁽³⁾. The only consumer products that undergo a formal registration process, as required by law, are pesticides, pharmaceuticals, and personal care products.

Upon joining the Organization for Economic Cooperation and Development (OECD) in 2010, Israel committed to developing a mechanism for chemical registration. As part of that commitment, the Ministry of Environmental Protection (MoEP) recently established a Chemical Registration Department, whose role is to implement international treaties such as the Stockholm, Rotterdam, and Minamata conventions, and to establish a mechanism for chemical registration.

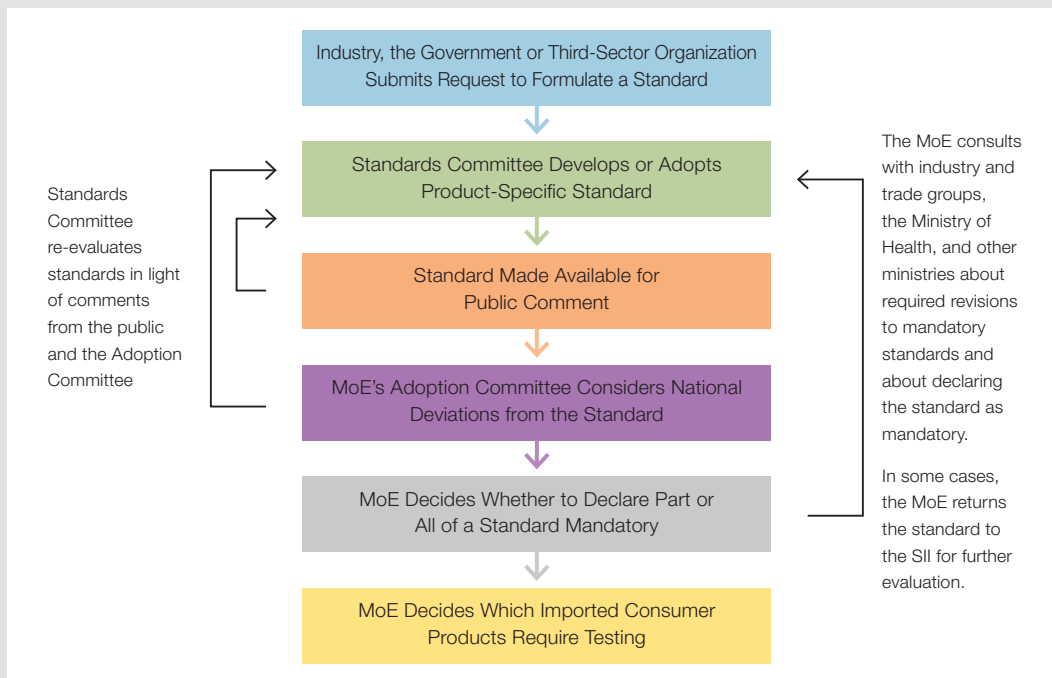
Currently, the Israeli regulatory framework for consumer products is based on non-binding standards and on mandatory product-specific standards (Figure 1). These product-specific standards are adopted and formulated by stakeholder committees coordinated by the Standards Institution of Israel (SII). Up to 12 members participate in each committee, including ten representatives from industry and trade organizations, academia, and consumer groups, plus two representatives from the government or public bodies.

Consumer products standards are generally based on international standards. Israeli standards can include unique national deviations which are requirements that do not appear in the international standard upon which the Israeli standard is based, but they must be well justified.

According to the Standards Law, the Ministry of Economy and Industry (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 must meet the requirements of the standard in order to be produced, sold, imported, or exported. An Adoption Committee (with representatives from the MoE, the Ministry of Finance, trade and industry organizations, and the public) reviews mandatory standards and makes recommendations pertaining to national deviations from mandatory requirements.

For imported goods, the Free Trade Ordinance lists the products that must meet the standard's requirements in order to be released by custom inspectors. Even if a standard is mandatory, if it is not included in the Free Trade Ordinance, the product may be imported based on the manufacturer's declaration rather than being tested in Israel prior to being released for local use or sale.

Process Overview: Developing Product-Specific Standards



← **Figure 1**
Source: Israel Ministry of Health

Product specific standards address the chemical content of various consumer products, including food contact materials (FCMs) and products for babies and children. Table 1 summarizes the chemicals that are regulated in consumer products for infants and children.

Standards for Consumer Products for Infants and Children, Including Requirements to Test for Chemical Contaminants, as of October 2017

Product / Standard Number	Heavy Metals	Phthalates	Bisphenol A (BPA)	Flame Retardants	Formaldehyde/Nitrosamines
Toys 562	+	+(in toys containing PVC)	-	-	-
Children's Jewelry 6558/1	Pending approval as mandatory standard	-	-	-	-
Baby Mattresses, Diaper Changing Mats 1548	-	Pending approval	-	Pending approval	-
Feeding Accessories for Children 14372	Pending approval as mandatory standard	+(in plastic)	Pending approval as mandatory standard	-	-
Cribs 682	+	-	-	-	+
Baby Bottles 5817	+	-	+	-	-
Pacifiers 1157	+	+	-	-	+

+ Testing is required by the mandatory standard

← **Table 1**
Source: Israel Ministry of Health

Food Contact Materials (FCMs)

Israeli Standard 5113 is a mandatory standard that requires chemical testing of total migration, BPA, and formaldehyde in plastic materials, products, and components that are in contact with food or beverages. In 2016, the standard was adapted to include both the United States Food and Drug Administration (FDA) and European Union (EU) regulations. A specific migration test was added to the requirements for overall migration. These changes are pending approval by the MoE.

An additional standard (Israeli Standard 1003) requires the testing of lead and cadmium in all ceramic-coated cookware and in FCMs made of ceramic, glass, or porcelain. However, according to the Free Trade Ordinance, there are no testing requirements for leaching of lead and cadmium from glass, porcelain, and ceramic-coated FCMs.

As shown in Table 1, Israeli Standard 14372 sets requirements regarding heavy metals, BPA, and phthalates in eating utensils for children. This standard was updated in 2017, based on the EU standard. This standard includes requirements for eating utensils made of any material, not only those made of plastic. In addition, this standard sets stricter maximum permitted levels for BPA in comparison to the requirements set in Israeli Standard 5113. The MoE has yet to declare this standard as mandatory.

Israeli Standard 900 addresses the safety of household electrical appliances, including electric kettles and coffee machines. According to Standard 900, electrical appliances in contact with water must meet the requirements of Israeli Standard 5452 for concentrations of heavy metals that could leach from the product into the water. This standard is mandatory, but no testing is required under the Free Trade Ordinance.

Toys and Playground Equipment

Israeli Standard 562, Part 3 (Safety of Toys: Migration of Certain Chemical Elements) is a mandatory standard that includes requirements to test heavy metals and phthalates in toys. The standard was updated in 2015 according to the last version of the EU standard. Maximum levels (MLs) of 11 metal elements were added to the MLs already set for 8 metal elements in the previous version of the Israeli standard. A national deviation limiting the ML of phthalates was added to this standard because phthalate content is regulated under other legislation in the European regulatory system.

Israeli Standard 1498 (Playground Equipment) addresses safety of playground equipment intended for children in playgrounds and public parks. The Ministry of Health (MoH) recommended adding requirements to test lead and cadmium in paints and coatings used on playground equipment, since there are no regulatory requirements in Israel limiting lead and cadmium in paints. This requirement was added to the standard, which is currently awaiting approval by the MoE.

Mattresses and Carpets

The mandatory standards for adult mattresses, infant mattresses, and carpets require flammability resistance. Until 2016, the flame resistance requirement included both the open flame test (“the

match test”) and the concealed flame test (“the cigarette test”). The requirement in Israeli Standard 5418 (Fire Resistance of Mattresses) to meet the open flame test was canceled to allow for the marketing of mattresses and carpets that do not contain chemical flame retardants. In addition, labeling requirements to indicate whether the product contains flame-retardant chemicals were added⁽²⁾. Changes to Israeli Standard 1548 (Mattresses and Head Protectors for Beds and Strollers for Infants and Toddlers) and Israeli Standard 636 (Carpet Textiles) that would permit the marketing of products that do not contain flame retardants are currently awaiting MoE approval.

Paints

There are no mandatory limits on lead in paint in Israel, but there are numerous voluntary standards that define maximum levels of lead content in paints. In addition, Israeli Standard 1343 includes a mandatory requirement to label paints with lead content exceeding 0.5%. The SII provides a voluntary “Green Label” for paint products that comply with lead restrictions and other requirements. Major paint companies in Israel declare that they comply with these requirements for residential paints. In addition, since there are mandatory lead restrictions for children’s furniture and toys, paints used for these products must comply with strict lead restrictions. In a study conducted in 2017 by researchers from the University of Haifa, the MoH, and the SII, high concentrations of lead were found in coatings and in painted surfaces in public areas such as playgrounds.

Personal Care Products

Personal care products are regulated in Israel and require specific approval by the MoH. In 2017, the MoH promulgated new regulations on the marketing of cosmetic products. The regulations adopt European policy on cosmetic products (EU Regulation EC 1223/2009), including the European list of prohibited and restricted substances in cosmetic products. These regulations forbid the use of substances categorized as carcinogenic, mutagenic, or hazardous to the reproductive system. Examples of prohibited substances include lead and its compounds, arsenic and its compounds, dibutyl phthalate, and diethylhexyl phthalate. Examples of restricted substances include dichloromethane and formaldehyde.

Data on Chemicals in Consumer Products in Israel

The MoE issued a number of public warnings and product recalls in 2015-2017, due to exceedances in chemical testing:

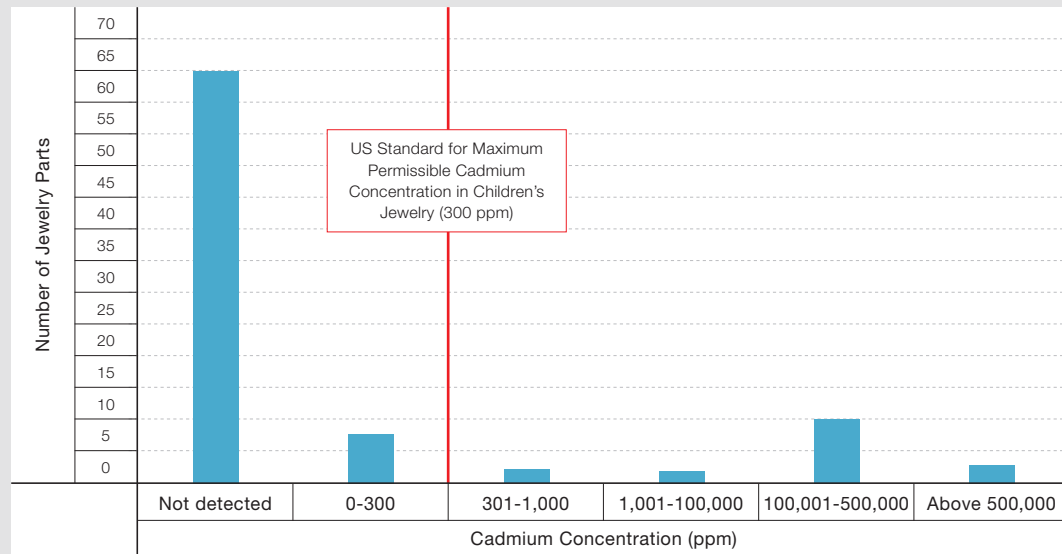
- In 2015, pacifiers containing nitrosamine levels above the standard were recalled.
- In 2016, children’s toys containing phthalate levels above the standard were recalled.
- In 2017, a public warning on heavy metals in coffee machines was issued.

In 2017, the MoH published a public warning on heavy metals in children’s jewelry⁽¹⁾. It is important to note that the MoE did not publish a public warning, because there is no mandatory standard for children’s jewelry in Israel and, therefore, the MoE has no authority over this product. The MoH issued the public warning based on the findings of a study conducted by researchers from the

University of Haifa, the MoH, and the SII; the study was designed to assess specific environmental contaminants - including heavy metals, phthalates, BPA, and brominated flame retardants (BFRs) - in consumer products for infants, toddlers, and young children. The study found no exceedances of heavy metals in the toys tested. However, 22% of the parts of children’s jewelry exceeded the United States standard for lead, 19% of the parts exceeded the United States standard for cadmium. The highest lead levels measured were above 10,000 ppm (compared to the standard of 100 ppm) and the highest cadmium levels measured were above 500,000 ppm (compared to the standard of 300 ppm) (Figures 2 and 3). The results were compared to the United States standard because there was no Israeli standard for heavy metals in children’s jewelry at the time the study was conducted⁽⁴⁾.

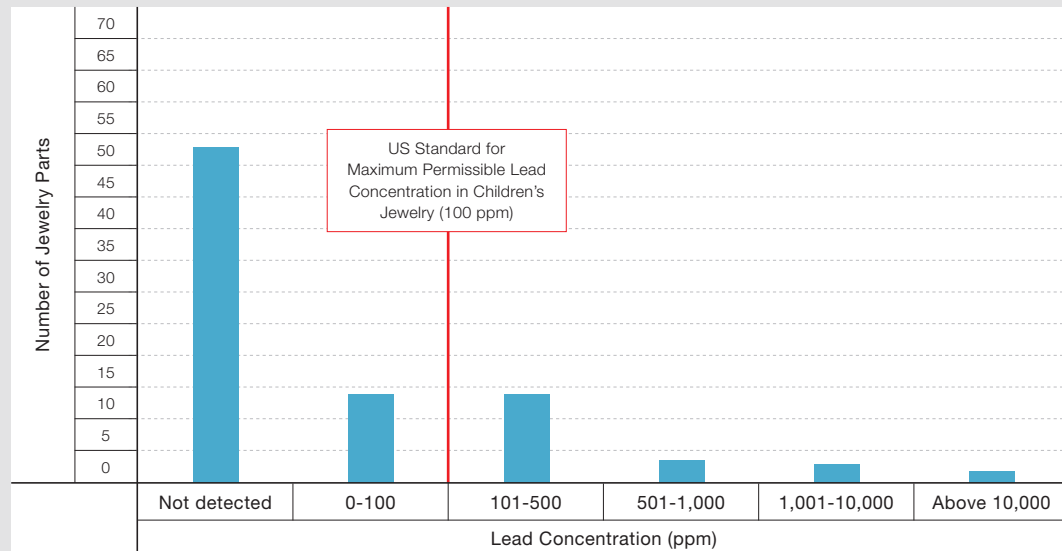
Cadmium Concentrations found in Children’s Jewelry Parts in Israel, 2016

→
Figure 2
Source:
Negev et al., 2017⁽⁴⁾



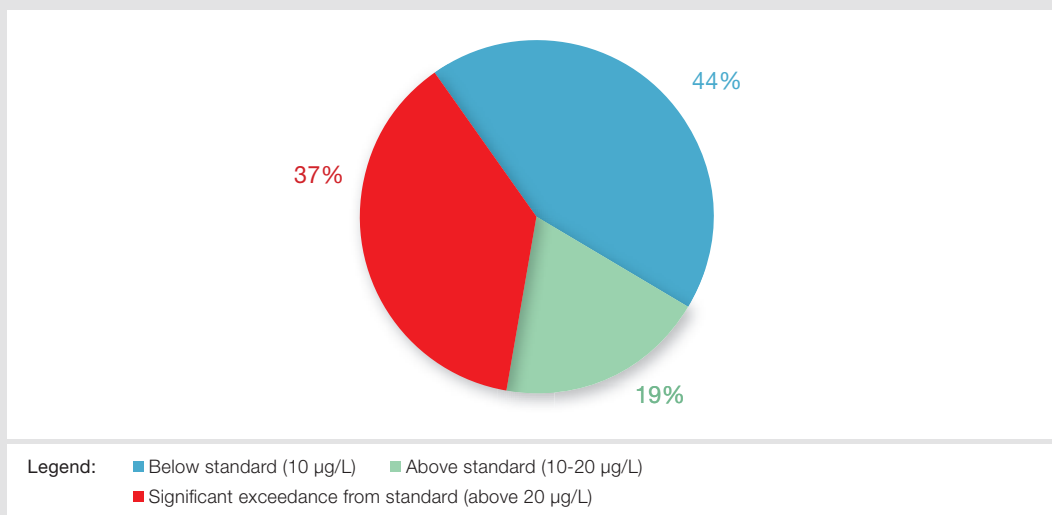
Lead Concentrations found in Children’s Jewelry Parts in Israel, 2016

→
Figure 3
Source:
Negev et al., 2017⁽⁴⁾



In response to data collected by a private company as part of routine testing of tap water, the MoE checked for lead and other metals in coffee machines. In over 35% of the machines tested, the lead concentration in the water in contact with the machines ranged from 20 to 150 µg/L, compared to the level of 10 µg/L permitted by Israeli Standard 900 (Figure 4).

Lead Concentrations in Water from Industrial Coffee Machines in Israel, 2016-2017



← Figure 4
 Source:
 Israel Ministry of
 Economy and Industry

Israeli Research on Chemicals in Consumer Products

- Researchers from the University of Haifa, the MoH, and the SII are examining whether paints containing lead are being sold in the Israeli market. The study primarily focuses on imported paints, paints produced locally by small manufacturers, and industrial paints.
- Researchers at Assaf Harofeh Medical Center and Tel Aviv Sourasky Medical Center are exploring predictors of exposure to phthalates and brominated flame retardants among pregnant women and newborns.
- Researchers at Tel Aviv Sourasky Medical Center and the MoH are studying whether bottle-fed infants are more exposed to phthalates and BPA than breastfed infants.

Progress Since 2014

Some progress has been made in achieving the goals cited in the *Environmental Health in Israel 2014* report. There has been progress in collaboration and data sharing among the MoH, the MoE and the SII - in order to promote new standards, to declare standards as mandatory, and to enforce existing mandatory requirements regarding consumer products. However, there is still no formal mechanism to ensure cooperation and the flow of information among the authorities.

Major Challenges

In Israel, there is a need for comprehensive regulation of chemicals in consumer products, in addition to the registration of chemicals. In the absence of this type of comprehensive regulation, there is a need for further research and surveys on chemicals in consumer products in the Israeli market in order to identify regulatory gaps. To date, these studies and surveys have been funded by the Environment and Health Fund. In addition, there is a need for a systemic review of the regulation of chemicals in consumer products marketed abroad as compared to the requirements in Israel.

The discovery in 2016 of very high lead and cadmium levels in children's jewelry on the market in Israel highlighted a regulatory gap that could potentially threaten public health. This stemmed from Israel's standards system, in which United States and EU product-specific standards are adopted without adopting comprehensive legislation in parallel. Following this discovery, the SII adopted a standard for children's jewelry, but until the standard is declared as mandatory, unregulated products continue to be imported and sold in Israel.

The discovery of high lead content in industrial coffee machines also highlighted regulatory gaps. While the requirements pertaining to coffee machines are mandatory, the Free Trade Ordinance does not require testing for lead or other chemicals in these products. Instead, importers are required to declare that the products meet the standard. According to the Free Trade Ordinance, only specific products require testing in order to be released by custom inspectors (e.g., toys), whereas others require a declaration only (e.g., coffee machines, drinking water dispensers). The Free Trade Ordinance requires chemical testing for imported products, but not for products made in Israel. Israeli-made products such as FCMs are tested sporadically in the market. There is a need for market inspections to discover noncompliant products.

An important challenge is to ensure that standards protect public health, despite political pressure and government decisions to reduce trade barriers and increase competition in the consumer product market. According to recent changes to the Standards Law (2017), Israeli standards can deviate from international standards, but these national deviations must be well justified and approved by the Adoption Committee, which does not include a representative from the MoH. The Standards Law explicitly states that the MoE cannot declare a standard as mandatory if it includes a national deviation, unless the declaration is approved directly by the Prime Minister and the Minister of Finance. In certain cases, the MoH has requested national deviations from standards to ensure that they protect public health. For example, in the absence of national requirements regarding heavy metals in paint, the MoH recommended adding requirements to test paints and coatings used in playgrounds for heavy metals. In light of the very strict criteria for establishing national deviations from international standards, and because of the need for approval by the Prime Minister and Finance Minister, there is likely to be increasing political pressure to adopt international standards as they are, even in the absence of comprehensive legislation in Israel pertaining to chemicals in consumer products.

An ordinance from the 1980s granted the MoH authority to regulate chemicals in consumer products, but the MoH has focused its efforts on submitting recommendations and requests to the MoE based on concern for public health. In the case of the standard for children's eating utensils (Israel Standard 14372), the MoE has yet to declare it mandatory, despite a formal request by the MoH in 2015. The lengthy bureaucratic process of declaring standards as mandatory is a major barrier to reducing potential risks from chemicals in consumer products. Since the updated Standards Law places more emphasis on reducing trade barriers than on protecting public health, there is a need to re-evaluate the role of the MoH in guaranteeing the adoption and implementation of standards that protect public health.

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Biomonitoring

Human biomonitoring (HBM) is a tool for measuring exposure to environmental chemicals by measuring substances, their metabolites, and biological markers at the cellular or molecular level, in the body's fluids and tissues, such as urine, blood, breast milk, and hair. HBM can be used to assess environmental exposures in humans at the individual level and in clinical medicine (for example, in diagnosing lead poisoning).

On the population level, HBM has emerged as a powerful tool for assessing cumulative exposure to mixtures of chemicals. HBM data can be combined with environmental data to identify exposure pathways, and with health data to support associations between human exposure to chemicals and adverse health outcomes, including subclinical effects. HBM can be used to identify and highlight vulnerable populations, to support the design of targeted policy measures to reduce exposure to environmental contaminants, and to assess the effectiveness of policies intended to reduce such exposure.

HBM data have many uses in environmental and health research and in policymaking. Thus, many countries, including the United States, Canada, Germany, France, Belgium, Spain, Italy, the Czech Republic, and South Korea, have developed National Biomonitoring Programs⁽⁵⁾.

Policy and Regulations

As in most European countries, there is no legislation in Israel requiring human biomonitoring in the general population. While the National Health and Nutrition Survey (MABAT) has served as a platform for HBM, there is no official policy on integrating HBM into these periodic surveys⁽⁴⁾.

Occupational biomonitoring in Israel is mandated by law for workers exposed to heavy metals (cadmium, lead, arsenic, chromium, mercury, cobalt, and nickel), organophosphate (OP) 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). There is no requirement to measure exposure to flame retardants, phthalates, phenols, and perfluorinated compounds in occupationally exposed populations.

In 2016, the Ministry of Health (MoH) initiated a preliminary prioritization process of chemicals for biomonitoring in Israel. Based on findings from the 2011 MoH Biomonitoring Study indicating widespread exposure in the Israeli population to chemicals, and additional criteria, such as the severity of the public health hazard and the potential uses of HBM data in policymaking, OPs and cotinine were identified as high priority for continued HBM in Israel⁽⁴⁾. The 2015-2016 National Health and Nutrition Survey (Rav-MABAT) included collection of urine samples in a subsample of 200 adults and 100 children for analysis of OP pesticides and cotinine.

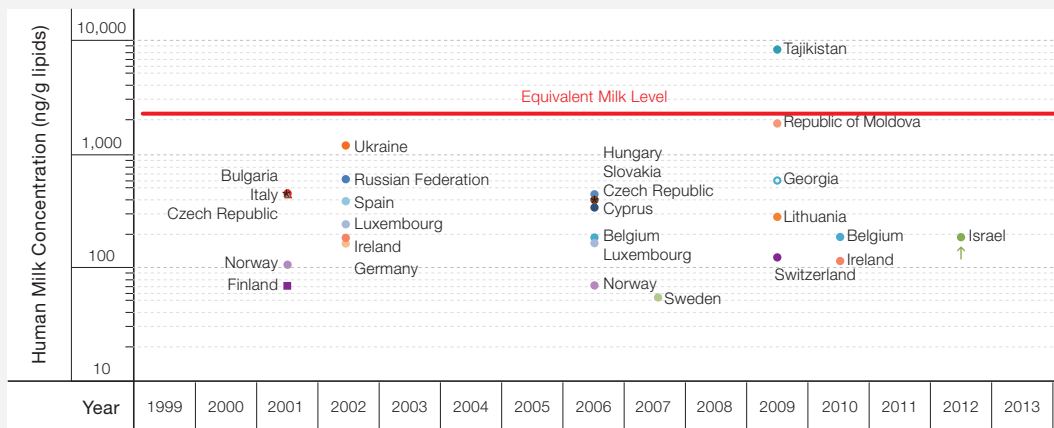
Data on Human Biomonitoring in Israel

The MoH conducted two biomonitoring studies in 2011-2012: (1) on persistent organic pollutants (POPs) in breast milk and (2) exposure of the general population to environmental chemicals (cotinine, OP pesticides, polycyclic aromatic hydrocarbons [PAHs], bisphenol A [BPA], and phthalates).

Since the publication of the *Environmental Health in Israel 2014* report, new findings from these studies were published:

- Urinary levels of the chlorpyrifos-specific metabolite TCPy among adults in Israel in 2011 were very high compared to those among adults in the United States. (Median creatinine-adjusted concentration was 2.34 µg/g, compared to 0.87 µg/g in the United States in 2009-2010).
- Analysis of urinary PAH metabolites indicated that the general adult population in Israel is widely exposed to these substances, with differences in levels and sources of exposure among ethnic subgroups⁽⁸⁾.
- While DDT levels in breast milk in Israel are lower than those reported in many European countries (Figure 1), the levels of PCDDs (polychlorinated dibenzo-p-dioxins), PCDFs (polychlorinated dibenzofurans), and PCBs (polychlorinated biphenyls) detected in the Israeli sample were above the calculated safe levels in breast milk⁽¹¹⁾.

DDT Concentrations in Breast Milk in European Countries: Data from the WHO/UNEP Human Milk Survey, 2000-2012

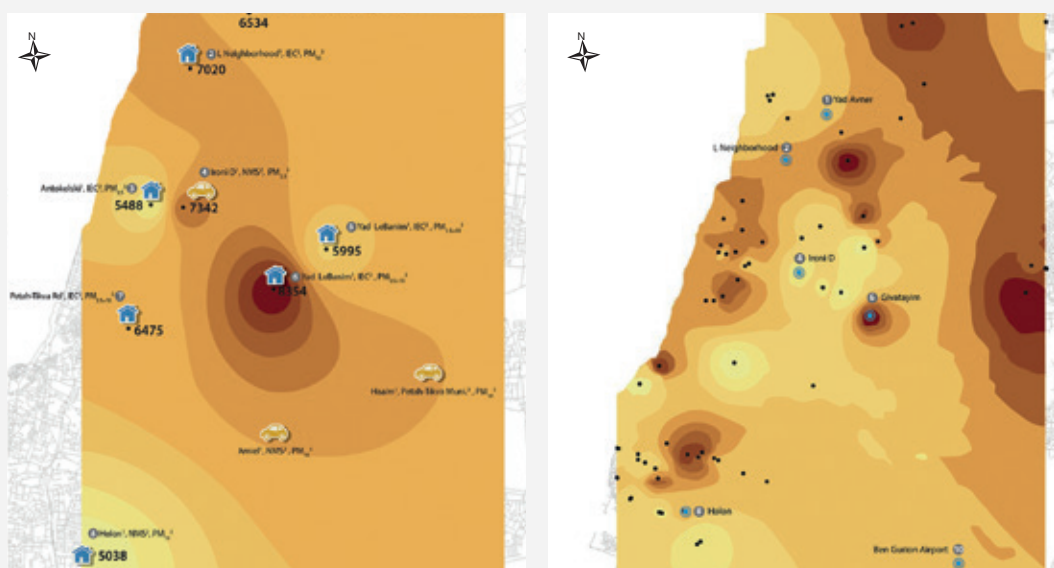


← Figure 1
Source: World Health Organization⁽¹²⁾

Human Biomonitoring Research in Israel

Researchers at Tel Aviv University mapped particulate matter (PM) dispersion in metropolitan Tel Aviv using biomonitoring techniques. Based on a study of sputum samples in adults referred for respiratory symptom evaluation, the researchers concluded that biomonitoring was more informative than environmental monitoring and enabled the mapping of wider areas (Figure 2). The team of researchers also assessed individual exposure to ultrafine particles in children with respiratory symptoms⁽²⁾. Ultrafine particle content in exhaled breath condensate was positively correlated with respiratory symptoms and airway inflammation.

Mapping of Air Pollution in the Tel Aviv Metropolitan Area Using HBM (right), compared with Mapping based on Fixed Monitoring Stations (left)



← Figure 2
Source: Lavi et al., 2016⁽⁷⁾

In a study of pregnant Bedouin women in southern Israel, researchers at Ben-Gurion University found higher urinary concentrations of aluminum among women residing within 10 km of the Neot Hovav industrial area, and among women who reported using a wood burning stove and cooking over an open fire. Exposure to aluminum was associated with birth defects, premature birth and low birth weight⁽⁶⁾.

A collaborative study by researchers from the MoH and from academia in the Palestinian Authority and in Germany showed that urinary OP metabolite levels (total dimethyl phosphates) were lower among pregnant Palestinian women compared to pregnant Jewish women in the Jerusalem area. The researchers suggested that the lower urinary concentrations of OP metabolites may result from lower consumption of fruits and vegetables in the Palestinian population and/or from more limited use of pesticides on the crops consumed by this population⁽¹⁾.

A pilot study conducted by researchers from Tel Aviv Sourasky Medical Center and the MoH studied exposure to pesticides and endocrine disrupting chemicals (EDCs) among vegans and vegetarians. The study showed that vegans and vegetarians had higher exposure to OP pesticides, with a modest reduction in exposure to phthalates compared to the general population in Israel⁽³⁾. The median creatinine-adjusted concentrations of total dialkyl phosphates (DAPs) and TCPy were significantly higher among vegan and vegetarian residents compared with the general Jewish population in Israel (0.29 $\mu\text{mol/g}$ compared to 0.16 $\mu\text{mol/g}$ for DAPs and 4.32 $\mu\text{g/g}$ compared to 2.34 $\mu\text{g/g}$ for TCPy). On the other hand, creatinine-adjusted concentrations of high molecular weight phthalates were 20% lower in vegans and vegetarians (88 $\mu\text{g/g}$ compared to 111.0 $\mu\text{g/g}$). The study highlighted the role of diet and lifestyle in exposure to environmental contaminants at the individual level⁽¹⁰⁾.

Researchers at Hebrew University's Center of Excellence in Agriculture and Environmental Health developed a novel technique for trace analysis of the antiepileptic pharmaceutical carbamazepine and its metabolites in human urine. This technique was used to show that healthy individuals who consumed treated wastewater-irrigated produce excreted carbamazepine and its metabolites in their urine, while subjects who consumed fresh water-irrigated produce excreted undetectable or significantly lower levels of carbamazepine⁽⁹⁾.

Ongoing Research

There are currently several large-scale birth cohort studies underway in Israel. These studies are using biomarkers of exposure, including biomarkers of exposure to brominated flame retardants, PCBs, phthalates, and OP pesticides. Several birth cohort studies are currently conducting follow-up examinations to explore the effects of exposure to environmental factors on childhood development. Several pilot studies for additional birth cohorts are being developed and some have begun (Table 1).

Birth Cohort Studies in Israel Utilizing Exposure Biomarkers

Birth Cohort	Sample Size	Contaminants Measured	Body Fluid or Tissue
Assaf Harofeh Medical Center / Tel Aviv Sourasky Medical Center	320	Brominated flame retardants, PCBs, phthalates	Maternal blood and urine, paternal blood and urine, umbilical cord blood, meconium, breast milk
Hadassah Medical Center	280	OP pesticides, phthalates	Maternal and infant urine
Ben-Gurion University / Soroka Medical Center	140	Heavy metals	Maternal urine
Ben-Gurion University / Soroka Medical Center (Pilot Study)	130	To be determined	Maternal blood and urine, paternal blood and urine, umbilical cord blood, placenta, meconium
Twin Cohort, Sheba Medical Center	65	Phthalates	Maternal urine and blood, umbilical cord blood, placenta
Tel Aviv Sourasky Medical Center (Pilot Study)	50	BPA, phthalates	Maternal and infant urine, meconium, breast milk
In Vitro Fertilization (IVF) Pregnancy Cohort at the Gertner Institute for Epidemiology and Health Policy Research (Pilot Study)	30	To be determined	Maternal blood and urine, paternal blood and urine, umbilical cord blood

← Table 1
Source:
Environment and
Health Fund

Additional HBM and environmental epidemiology studies using biomarkers for exposure assessment include:

- Levels of cotinine and OP pesticide metabolites will be measured in urine samples from 200 adults and 100 children; the samples were collected in the National Health and Nutritional Survey 2015-2016 (Rav-MABAT).
- The Ministry of Environmental Protection is funding HBM exposure assessment studies as part of the National Plan to Reduce Air Pollution in Haifa Bay. Contaminants of interest for biomonitoring include heavy metals and volatile organic compounds, such as benzene and xylene.
- Researchers at Hebrew University's Center of Excellence in Agriculture and Environmental Health are exploring the association between biomarkers of exposure to pesticides and male reproductive health.
- Researchers at Hebrew University-Hadassah and at Clalit Health Services are studying how biomarkers of exposure to environmental tobacco smoke and phthalates are associated with respiratory function in children.
- Researchers at Hebrew University-Hadassah are using biomarkers of POPs in serum to explore risk factors for non-Hodgkins lymphoma in Palestinian and Israeli adults.

Progress Since 2014

In *Environmental Health in Israel 2014*, the major challenges in the field of biomonitoring included the lack of regional or international harmonization, the lack of a long-term plan for HBM in Israel, and the absence of laboratories with proven capacity to measure low-level exposure to environmental contaminants in biological samples.

Significant progress has been made in joining a regional harmonization effort. The MoH is participating in the HBM4EU project, a consortium of 28 European countries promoting the use of HBM as a tool for policymaking and risk assessment. The MoH's primary roles in the consortium will be to examine the use of health surveys as a platform for HBM, and to participate in a project on exposure to chemical mixtures, with a focus on pesticides. As part of the HBM4EU project, biomonitoring data from Israel will be integrated into the European Information Platform for Chemical Monitoring.

There has been some progress in developing the laboratory capacity for HBM in Israel. The Public Health Services Laboratory at the MoH received a grant in 2017 from the Environment and Health Fund to develop laboratory capacity for HBM.

There has been little progress in the development of a long-term strategic plan for HBM in Israel.

Major Challenges

In 2015-2016, the National Health and Nutrition Survey (Rav-MABAT) served as a platform for collecting urine samples for HBM. The use of the survey as a platform for HBM has many advantages, but to date HBM has been an adjunct part of the survey. In order to maximize the potential of using these periodic surveys as a platform for biomonitoring surveys, HBM elements should be considered and integrated early in the planning stages, and HBM should be an official part of the National Health and Nutrition Surveys. The preliminary process of selecting and prioritizing chemicals for HBM in Israel should be expanded to include additional representatives from academia, government, and the public.

There is an abundance of HBM data being generated in Israel from birth cohort studies and from other ongoing studies in the field of environmental epidemiology. There is a need to develop a framework for using research data from cohort studies and other studies to inform policymaking and risk assessment. To date, HBM data has not been integrated into quantitative risk assessments for environmental chemicals in Israel.

Many countries have established national biomonitoring programs. While the lack of a formal HBM strategic plan in Israel has allowed flexibility in setting goals and finding sources of funding, and has facilitated collaboration with the research community, an official government program would secure the long-term sustainability of HBM efforts in Israel.

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Non-Ionizing Radiation

Non-ionizing radiation (NIR) refers to electromagnetic radiation with insufficient energy to ionize atoms or molecules. NIR includes the spectrum of ultraviolet (UV) light, visible light, infrared radiation (IR), microwave (MW), radio frequency (RF), and extremely low frequency (ELF) radiation. Radiation from wireless communication facilities, including cellular phones and networks, is within the radio frequencies⁽¹⁴⁾.

Numerous studies have examined the possible health effects of NIR. Exposure to radio waves can cause localized tissue heating. However, the main concern regarding the potential health risks of NIR focuses on the possibility that it has non-thermal effects.

The International Agency for Research on Cancer (IARC) classified ELF magnetic fields and RF electromagnetic fields as “possibly carcinogenic to humans” (Category 2B). Studies indicate an increased risk of developing leukemia (by a factor of 1.5-2) following prolonged residential exposure to magnetic fields (above 0.3-0.4 microTesla [μT], equivalent to 3-4 milliGauss [mG]). According to an IARC assessment from 2011, there is limited evidence supporting an increased risk of developing malignant brain tumors (glioma) and benign tumors of the auditory nerve (acoustic neuroma) among cell phones users.

A limited number of studies have assessed the possible association between exposure to RF and adverse health outcomes, such as fertility problems; impaired brain functioning; heart and circulatory system malfunction; hearing loss; changes in the secretion, composition, and flow of saliva; and neurodegenerative diseases. The results of studies that examined the effect of RF on sperm quality parameters are equivocal.

Policy and Regulations

The Ministry of Environmental Protection (MoEP) has the authority to determine environmental standards for NIR. The Ministry of Health (MoH), the Ministry of Education (MoEd), the Ministry of Communications, the Ministry of Energy, the Ministry of Interior, and the Ministry of Economy and Industry are also involved in developing and implementing policy on NIR. The Standards Institute of Israel (SII) is responsible for issuing Israeli standards for NIR emitting devices.

The 2006 Non-Ionizing Radiation Law includes requirements related to the installation and operation of energy-emitting sources, as well as requirements for monitoring NIR sources and publicizing the results. The law gives the MoEP the mandate to set maximum permitted exposure levels⁽⁷⁾. In 2011, the MoH and the MoEP recommended guidelines for maximal permitted levels of exposure to radiation from electric installations (10% of the thresholds defined by the International Commission on Non-Ionizing Radiation Protection [ICNIRP]). These recommendations have not been translated into regulations due to opposition by the Ministry of Energy and the Ministry of Finance. In 2015, an appeal was submitted to the Supreme Court demanding that the MoEP establish regulations regarding exposure to ELF. No progress on this subject has yet been achieved; the main stumbling block is a disagreement over the cost of implementing the regulations.

Following a government decision, the MoEP and the Ministry of Science and Technology established the Israeli National Information Center for Non-Ionizing Radiation (TNUDA) in 2013. The TNUDA Center collects and compiles scientific knowledge on non-ionizing radiation and its impact on public health, analyzes it, and makes it available to a variety of target audiences (the general public, government, researchers, and commercial enterprises). The Center recommends measures to reduce exposure to NIR and potential health hazards. TNUDA seeks to expand knowledge in this field and to guide the public in making educated decisions regarding the use of technologies involving NIR⁽¹³⁾.

In 2016, the MoEP published guidelines for reducing exposure to electromagnetic fields surrounding electric facilities. The guidelines include recommendations for planning and construction of power facilities, with an emphasis on passive and active protection technologies to reduce exposure to radiation, such as creating buffers between the magnetic fields and the protected area, or creating counter-magnetic fields to oppose the existing fields in the protected area⁽⁸⁾.

In recent years, several laws that restrict the use of cell phones among children have been proposed, including the prohibition on selling, marketing, and advertising cell phones to children under the age of 16. None of the proposed laws have been passed.

Policy on Exposure to NIR in Schools

In 2013, the MoEd issued guidelines stating that wired communication is preferable when using the internet in the classroom. If it is unfeasible to install a wired network, a wireless network can be installed, with the following limitations:

- Age limitations: The wireless network can be installed for grade 1 and upwards, but not in kindergarten. For grades 1-3, daily use is limited: for grades 1-2, up to one hour per day and not more than 3 days a week; for grade 3, up to two hours a day and not more than four days a week.
- A wired access point at the teacher's post should be installed in each classroom.
- Radiation measurements (RF and ELF) of school communications equipment and end-user devices should be conducted. The measurement should be performed by an authorized person, before and after installation, in order to ensure that radiation levels meet MoEP requirements.
- Schools should have educational programs about electromagnetic and RF radiation.

A circular published in 2016 by the MoEd limits the duration of digital learning and states that computers or tablets should be used only for pedagogical activities. It also limits the duration of electronic learning; for example, not more than 20% of the lesson in grades 1-3, and not more than 30% of the lesson in grades 4-6^(5,6).

Data on Exposure to NIR in Israel

According to data published by the MoEP, 1,005 ELF measurements were conducted in schools in 2014, and higher-than-recommended levels of radiation were found in 561 of them. In 2015, 346 of the 617 measurements conducted were found to exceed recommended radiation levels (Table 1)⁽⁹⁾.

Extremely Low Frequency (ELF) Radiation Measurements in Schools in Israel, 2014-2015

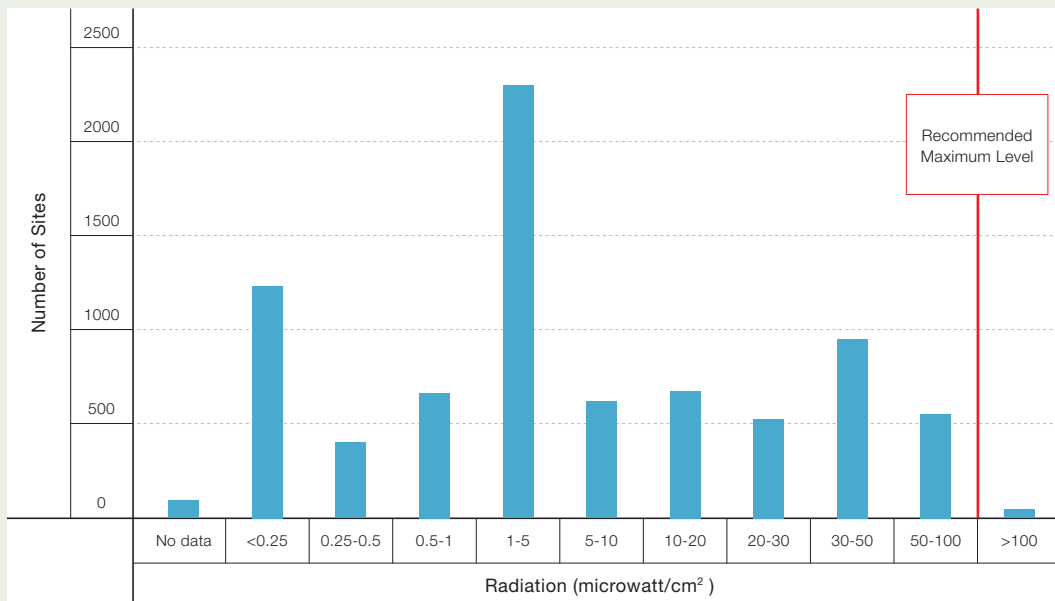
Year	Total Number of Measurements	Number of Measurements Exceeding the Recommended Radiation Level	Percentage of Measurements Exceeding the Recommended Radiation Level
2014	1,005	561	55.8%
2015	617	346	56.1%

←
Table 1
Source:
Israel Ministry of
Environmental
Protection⁽⁹⁾

The MoEP publishes the locations of RF monitoring systems and their measurements on the RF Monitoring System website⁽¹⁰⁾. The MoEP also tracks and monitors cellular antenna transmission in Israel. A report from early 2017 lists 7,950 active cellular transmission sites in Israel and provides data on their radiation levels (Figure 1). It should be noted that the radiation levels of 33 of the 7,398 antennas examined were higher than the recommended threshold of 100 microwatt/cm², but that the exceedances were measured in zones inaccessible to the general public.

NIR Levels at Active Cellular Transmission Sites in Israel, 2017

→
Figure 1
 Source:
 Israel Ministry of
 Environmental
 Protection⁽¹⁰⁾



The Gertner Institute for Epidemiology and Health Policy Research conducted an educational intervention program and survey during the years 2012-2014 in central Israel, with the participation of eight schools, including 80 seventh and ninth grade classes. The findings indicated significant cell phone use among adolescents in Israel. For example, most of the students (96.1%) used cell phones on a regular basis, 27.8% spent more than one hour on voice calls daily, and 11% spent more than two hours on a typical day. About 28% reported receiving and sending more than 50 text messages per day and 7.4% reported more than 300 text messages per day. Most of the cell phone users (95.6%) began using a cell phone before age 12 (8.4% before age six), 30% reported that they answer phone calls inside elevators, and about 80% never use earphones or other hands-free devices while talking on a cell phone.

A survey conducted by one of the major cellular network operators in Israel found that 25% of children ages 6-8 owned a cell phone; this percentage increased to 66% among children ages 9-11.

Research on Exposure to NIR in Israel

Exposure to RF and Magnetic Fields

In 2015, researchers from the MoEP and Hadassah Academic College examined the effects of the transition to Long Term Evolution (LTE - a standard for very highspeed wireless communication for cell phones and data terminals) on exposure to RF. The researchers found that the transition to LTE decreased exposure to RF, despite an increase in the volume of transferred data, and that site sharing among operators can decrease the number of sites by 40% while also reducing exposure to RF.

Researchers from the Soreq Nuclear Research Center (NRC) conducted a national survey of radiation from various sources. In this study, published in 2015, the researchers measured ELF magnetic fields in ten models of gasoline, diesel, and hybrid cars, and found that the magnetic field in hybrid cars was the strongest, while the magnetic field in diesel cars was the weakest. According to this survey, the metal chassis of the cars may be a source of the magnetic field⁽³⁾.

In another study, which began in 2015, researchers from the MoEP and Hadassah Academic College quantified the exposure to LF magnetic fields in a train powered by diesel (instead of electricity). In such trains, electricity is produced by a diesel generator located in the locomotive, which in turn powers the electric motors that drive the wheels of the railcars. The researchers measured the radiation in the passenger seats and found a level of more than 6 μ T.

Health Effects of Exposure to NIR

The TransExpo Project (Childhood Leukemia and Residences near Electrical Transformer Rooms), which began in 2009, aims to evaluate the association between exposure to magnetic fields in the ELF range in residential areas and the incidence of leukemia among children. Seven countries, including Israel, are participating in this project.

Researchers from the Gertner Institute for Epidemiology and Health Policy Research are investigating the possible long-term health effects of magnetic resonance imaging (MRI), a medical technique used to diagnose a range of illnesses. During MRI procedures, the patient is placed inside a strong magnetic field, and is also subjected to radio waves. Health outcomes were examined in two different studies: The first aims to assess the possible effects of in utero exposure to MRI on neurodevelopment, future patterns of behavior, and hearing disabilities. The second study assesses the association between the exposure of children to NIR and the risk of cancer, using a large cohort of 260,000 participants, ages 0-17 years. This study was conducted in collaboration with the Research Institute of Clalit Health Services.

The international GERoNiMo (Generalized EMF [electromotive force] Research using Novel Methods) study involves 19 research institutes from 13 countries, including Israel. Launched in 2014, the study aims to close the knowledge gaps on the health effects of EMF and to identify ways to reduce exposure. The GERoNiMo study expands the objectives of the international MOBI-Kids epidemiological project, which examines the association between the use of cell phones and the risk of brain tumors in children and adolescents. It also uses personal questionnaires to expand the population sample and extend exposure assessment to include intermediate frequencies (in addition to ELF, RF, and other environmental factors already included in the assessment)⁽¹⁾.

Health Effects of Exposure to Electromagnetic Radiation from Cell Phones

A study published in 2016 by researchers from Tel Aviv University and the Rabin Medical Center aimed to evaluate the potential carcinogenic effects of radiofrequency energy (RFE) emitted by cell phones on human thyroid primary cells. The researchers examined thyroid cells that were

irradiated under different conditions that simulated the RFE emitted by cell phone, and found no carcinogenic effect on human thyroid cells or association between RFE from cell phones and thyroid cancer⁽¹²⁾.

The international INTERPHONE study was conducted in 14 countries, including Israel, from 2000 to 2007. This study aimed to determine whether cell phone use increases the risk of four types of tumors (glioma, meningioma, parotid gland, and acoustic nerve tumors)⁽⁴⁾. The results, published in 2016, suggest that tumor location is associated with the way cell phones are used. For example, more gliomas occurred closer to the ear on the side of the head where the cell phone was reported to have been used the most.

As noted above, the MOBI-Kids study is investigating the association between cell phone use and the risk of developing brain tumors among children and adolescents. Sixteen countries are participating in this international case-control study, including Israel, where 293 participants were recruited. The MOBI-Kids study uses personal questionnaires to address exposure to intermediate frequency radiation, in addition to RF, ELF and other environmental factors⁽¹¹⁾.

Progress Since 2014

In *Environmental Health in Israel 2014*, the major challenges noted concerning NIR were the publication or renewal of recommendations on maximum levels of NIR, and the regular monitoring of devices (such as transformers and power lines) in public spaces. Some progress has been made on both objectives.

Major Challenges

Despite some progress, there are still no binding regulations on the permitted levels of NIR in Israel. There is considerable research underway on exposure to NIR in Israel and its adverse effects, but further research in this field is needed, especially multidisciplinary research that includes biology, medicine, physics, engineering, epidemiology, and public health. The challenge will be to use the data generated from this research to improve health risk assessment and to pass this knowledge on to the public and policymakers.

There is low compliance with the MoH recommendations on reducing exposure to NIR (for example, using a speakerphone or earbuds). Increasing public awareness regarding the potential adverse health effects of NIR, and increasing compliance with recommendations to reduce exposure and potential risk, remain a major challenge.

In addition to exposure to NIR, there is increasing concern that the use of cell phones, tablets, and other communication devices may have other indirect adverse health effects,

especially among children⁽²⁾. These effects, which are unrelated to radiation, include addiction, social problems, psychological effects, sleep disturbances, and obesity. The TNUDA Center addresses these issues in its research program. However, there is a need for formal government recommendations and guidance, especially regarding children.

The Ministry of Energy's Smart Cities Administration aims to apply information and communication technologies in local government to improve administrative, regulatory and economic aspects. Expanding the coverage of wireless internet networks in cities and wider use of RF communication may increase the public's exposure to electromagnetic fields. In addition, there are plans to convert household water and gas meters to wireless smart meters. This may further expose the public to RF fields. The potential impact of Smart City technology and smart meters on the public's exposure to NIR has yet to be evaluated.

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Climate Change

Climate change poses serious threats to public health. Extreme heat contributes to deaths from cardiovascular and respiratory disease, and an increase in the number of extremely hot days can lead to an increase in preterm births. High temperatures raise the levels of ozone and other pollutants in the air, which exacerbate cardiovascular and respiratory disease, including asthma in children. Increased frequency of dust storms may increase the risk of related respiratory illnesses and loss of work/school days. Extreme weather events and natural disasters, such as floods, can lead to an increased risk of water-borne diseases. High temperatures can be detrimental to sanitation and increase the risk of food spoilage due to the proliferation of bacteria or mold. Finally, climate change is expected to impact the incidence of vector borne diseases (for example, West Nile Fever, malaria, and cutaneous leishmaniasis), as well as pesticide use for pest control. According to 2014 estimates by the World Health Organization (WHO) on global morbidity and mortality due to climate change, 38,000 elderly people will die from heat exposure in 2030; another 48,000 deaths will result from gastrointestinal diseases following consumption of food or water contaminated by bacteria or mold; malaria will cause 60,000 deaths; and childhood undernutrition will cause an additional 95,000 deaths⁽¹⁶⁾.

Policy and Regulations

Mitigation

Prior to the Paris Climate Change Conference in 2015, Israel declared its goal of an unconditional economy-wide target of reducing per capita greenhouse gas emissions by 26%, from the levels measured in 2005. This translates to specific policy targets in various sectors in the economy,

to be achieved by 2030: a 17% reduction in electricity consumption; the generation of 17% of consumed electricity from renewable energy sources; and a 20% reduction in transportation emissions. In 2016, the Israeli government approved a national plan to mitigate greenhouse gas emissions and to increase energy efficiency.

Adaptation

The National Adaptation Plan for climate change, which includes specific action plans for various government ministries, was initiated following a binding government resolution in 2009. The plan, which awaits government approval, identifies knowledge gaps regarding climate change in Israel and proposes a wide-ranging research plan to close these gaps. Furthermore, following a government-wide consultation process, the plan reviews the impact of climate change and extreme weather events on various sectors in the economy, and suggests sectoral action plans, including the development and implementation of tools and technologies for coping with climate change⁽⁸⁾.

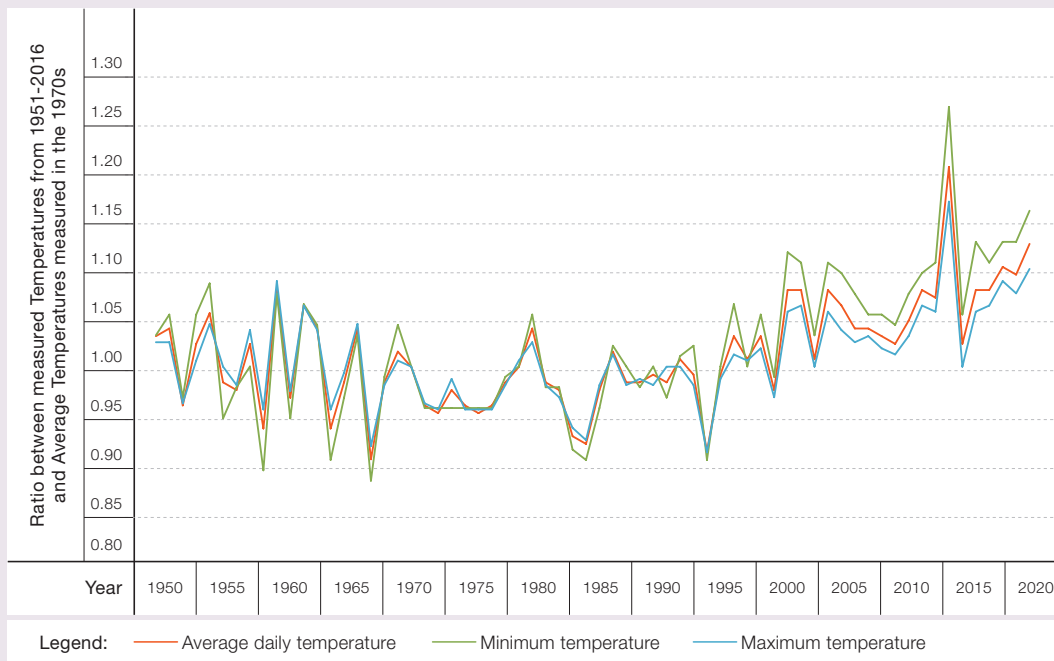
In 2015, the Ministry of Environmental Protection (MoEP) held a national conference on climate change. Representatives from 12 government ministries, academic institutions, non-governmental organizations, the Israel Meteorological Service (IMS), and the Hydrological Service participated in the event, which focused on plans and strategies for climate change adaptation⁽⁹⁾.

The Ministry of Health's (MoH) preparations for climate change have focused on short-term responses to extreme climatic events (e.g., heat waves, cold waves, and floods). This includes a plan to upgrade the preparation of hospitals and medical systems as part of the emergency system. The MoH published an infographic on climate change, which includes recommendations for coping with extreme heat waves, with an emphasis on the elderly⁽¹²⁾. The MoH publishes warnings to the public on upcoming heat waves and extreme cold events, with recommendations for the general public and vulnerable populations, including the elderly and individuals with chronic disease. However, there is still a need for long-term preparations for climate change, including promoting research (with a focus on the implications for public health), improving the accessibility of relevant information to the public, and collection of clinical data, such as incidence and prevalence of climate-change related diseases.

Data on Climate Change and its Health Effects in Israel

A series of studies conducted by the IMS show that the average temperatures since 2000 are much higher than the average temperatures measured in the 1950s, 1960s, and 1970s (Figure 1). These differences in temperature are even more significant when examining the minimum temperatures measured in the summer (June, July, and August). According to these measurements, June 2016 was the hottest month on record, with the average daily maximum temperature between 2.5 and 3.5 degrees Celsius higher than the average daily maximum temperature measured during the years 1995–2009^(3,5).

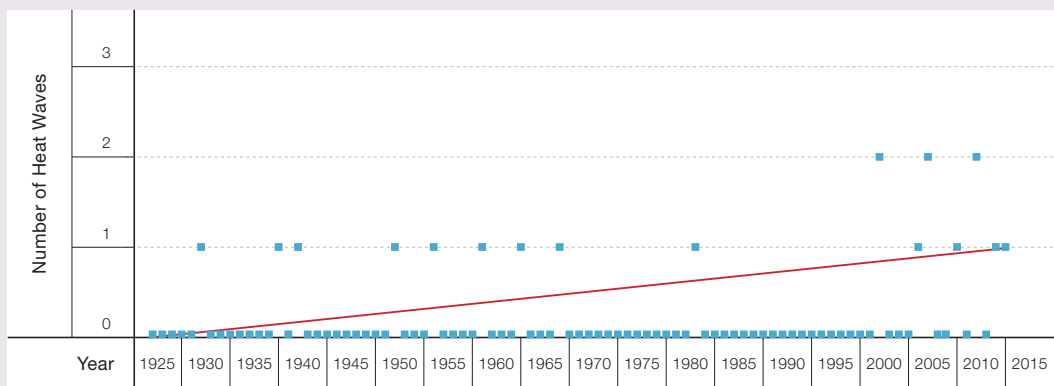
Ratio between Minimum, Average, and Maximum Temperatures measured in Israel from 1951-2016 and the Average Values measured in the 1970s



← **Figure 1**
Source: Israel Meteorological Service⁽³⁾

According to an IMS report published in 2016, there has been a statistically significant increase during the last two decades in the frequency of heat waves, in which the average daily temperature was at least 6°C higher than average for three consecutive days (Figure 2). A statistically significant decrease in the intervals between heat waves was also observed⁽⁵⁾.

Number of Annual Heat Waves in Jerusalem, 1927-2015



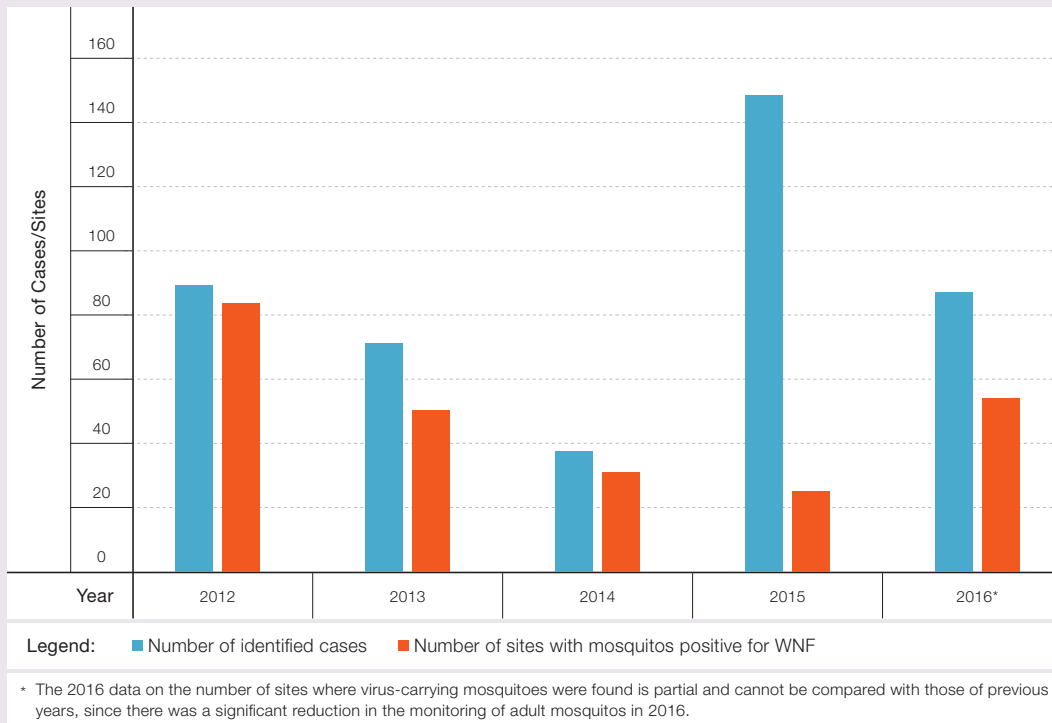
← **Figure 2**
Source: Israel Meteorological Service⁽⁵⁾

The winters of 2013/2014 and 2015/2016 were the driest on record in northern Israel. In recent years, there were several extreme weather events in which dry months were followed by strong easterly winds, causing a dramatic decrease in humidity. Such events create climate conditions that increase the likelihood of wide-scale wildfires, as happened in the winters of 2010 and 2016⁽⁴⁾.

According to MoH data, there was a gradual decrease in the number of cases of West Nile Fever (number of individuals infected with the disease) during the years 2012-2014, along with a decrease in the number of sites where mosquitos carrying the virus were found. A sharp rise in the number of people infected with the disease occurred in 2015 (Figure 3)⁽¹¹⁾.

West Nile Fever in Israel, 2012-2016

→
Figure 3
 Source:
 Israel Ministry of
 Health⁽¹¹⁾



Since 2002, there has been a dramatic increase in the cases of cutaneous leishmaniasis: from 1 case per 100,000 in 2002 to 4.5 cases per 100,000 in 2012. Since 2012, the incidence rates have decreased (2.7 cases per 100,000 in 2015). Before the mid-1990s, most of the cases of leishmaniasis in Israel were caused by the *Leishmania major* parasite. In the last 15 years, there has been an increase in the number of cases caused by *Leishmania tropica* (*L. tropica*)⁽²⁾.

Research in Israel on the Health Effects of Climate Change

An Israeli-Palestinian study published in 2016 analyzed *L. tropica* strains in Israel and in the Palestinian Authority. The researchers found 96 different *L. tropica* strains in Israel and in the Palestinian Authority. The researchers also found a new group of *L. tropica* strains in northern Israel that are close evolutionarily to strains from Africa, as well as other new strains that are very close evolutionarily to Asian strains. These strains were found both in Israel and in the Palestinian Authority. This is likely due to climate and environmental changes, in addition to

direct effects of human activities, such as migration and population movements between states and continents⁽¹⁾.

A study published in 2016 by researchers from the Hebrew University of Jerusalem showed that climate change and global warming may increase the risk of herbicide-resistant weeds due to enhanced detoxification. The researchers examined the response of different weeds to herbicides under different temperatures and found that high temperature causes evolutionary changes in the metabolism of weeds, and these changes increase their metabolic resistance to herbicides. Increased resistance to herbicides may affect human health through crop decreases that could drive up the price of fruits and vegetables and thus affect nutrition, and by increasing the amount of pesticides, which would result in higher public exposure to pesticide residues⁽¹⁴⁾.

A joint study published in 2015 by researchers from the University of Haifa and the MoEP investigated how different Mediterranean countries were preparing for climate change, in particular through adaptation and preparations to cope with vector-borne diseases, which have proved to be influenced by climate change. The researchers focused on six representative Mediterranean countries (Israel, Egypt, Turkey, Malta, Italy, and Spain) and found that all six countries have begun to prepare for this threat. However, policy implementation in these countries is still limited and basic. The researchers also pointed out that cross-border cooperation, which is crucial for coping with this challenge, is not stable and depends on international frameworks⁽¹⁵⁾.

Preliminary results from an ongoing study at Ben-Gurion University in collaboration with the MoH indicate that meteorological factors are responsible for the geographic variation in morbidity caused by *Campylobacter* bacteria.

Progress Since 2014

In the *Environmental Health in Israel 2014* report, the major challenges related to climate change included developing a national action plan to cope with climate change. Other challenges included implementing a national plan to combat cutaneous leishmaniasis, strengthening collaboration between the IMS and the MoH, and creating a nationwide database on the health implications of climate change. While significant progress has been made in developing a national strategy for coping with climate change (recommendations are expected to be submitted to the government at the end of 2017), and significant progress was achieved in implementing the national plan to combat cutaneous leishmaniasis⁽¹⁰⁾, on other topics, there has been little or no progress. The MoH, in collaboration with cutaneous leishmania experts and the Israel Society of Dermatology and Venereology, issued a position paper in February 2016 with the aim of raising awareness about the disease and its diagnosis, and of standardizing the treatment of diagnosed patients⁽²⁾.

Major Challenges

Creating a nationwide database on the health implications of climate change remains a major challenge. Data on heat-related morbidity and mortality is required, as well as an analysis of the incidence of asthma and allergies, and other diseases related to climate change. An assessment of national adaptation to climate change is needed, in particular on the public health impact of factors such as desertification, fires and flooding, and increased reliance on desalinated drinking water. As precipitation continues to decrease and natural drinking water sources continue to dry out, there will be increasing reliance on desalinated drinking water, including in northern Israel. The adverse impact on public health of decreased magnesium, fluoride, and iodide intakes may be indirect effects of climate change.

One of the challenges related to climate change is the lack of specific indicators. In 2015, the MoEP hosted two workshops on Climate Change Adaptation Indicators, including health indicators. The workshops focused on approaches and experiences of climate adaptation monitoring in several European countries^(6,7).

Long-term adaptation to climate change remains a challenge that requires political support, inter-ministerial collaboration, and considerable resources. Regarding climate change mitigation, Israel declared its target of emissions reduction by 2030, including a 20% reduction in the use of private transportation. This continues the positive trend of increased public transportation use that occurred during 2010–2015⁽¹³⁾. However, data from the Central Bureau of Statistics published in 2017 indicates a sharp increase (5.6%) in the number of private cars purchased in Israel in 2016.

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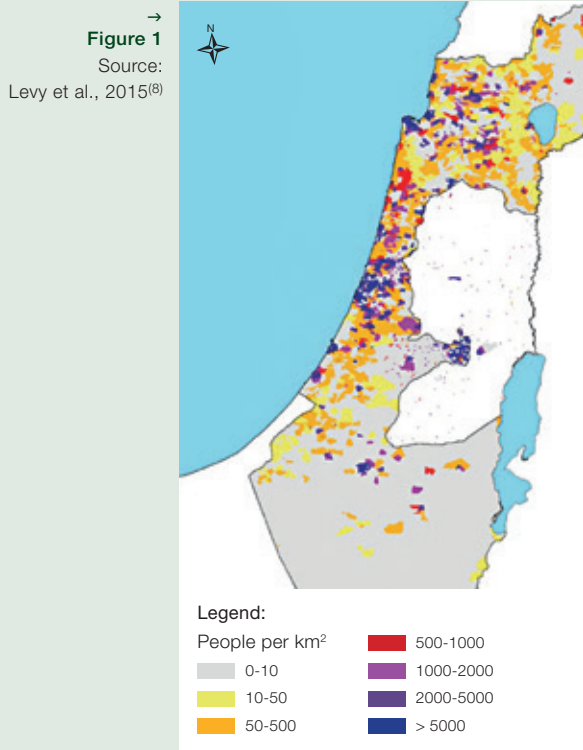


Planning

Rapid development, industrialization, urbanization and the resulting increase in pollution and population density affect public health in a number of ways. There is evidence that living near industrial areas and major roads increases exposure to air pollution and noise, and increases the risk of morbidity and early mortality. Recent studies show that living in proximity to green spaces contributes to mental health and healthy birth outcomes, reduces cardiovascular morbidity, and lowers the rate of early mortality.

Health- oriented planning of open public spaces and their microclimates is essential for reducing exposure to ultraviolet (UV) radiation and for promoting an active lifestyle. Transportation planning, in particular the proper design of public transportation networks, can have a significant effect on public health by promoting cycling and walking, and reducing exposure to air pollution. Energy resource planning has a potential impact on public health, particularly in a densely populated country such as Israel, where energy production still relies primarily on fossil fuels (in 2016, 36% of energy from power plants was based on imported coal).

Population Density in Israel, 2008



Israel is a small country (20,000 km²) and most of its territory is unavailable for development (e.g., because of extensive military training zones). Israel is one of the most densely populated countries in the world (with an average of 394 people per km²); the highest population density is in the center of the country (Figure 1).

Policy and Regulations

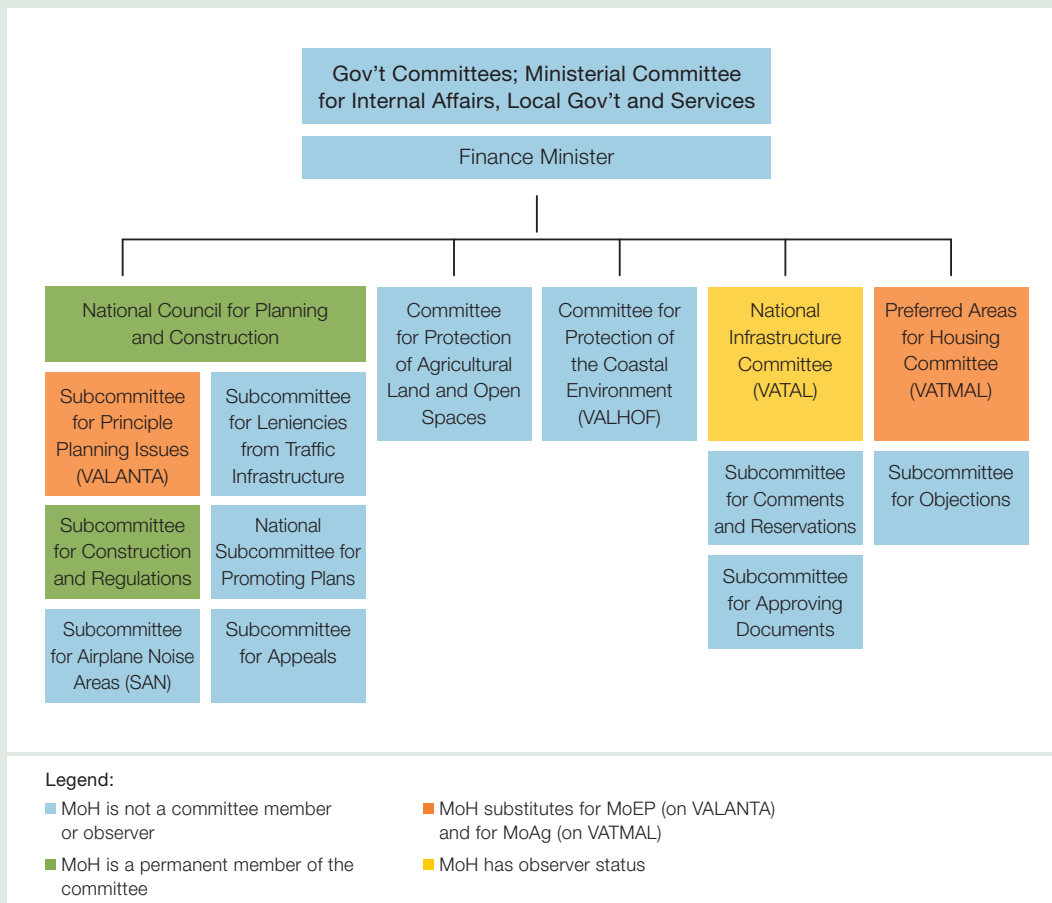
The Israel Planning Authority (IPA) is a hierarchical governmental body that promotes, regulates, and administers plans for the development of land for housing, infrastructure, industry, and the use of natural resources. The IPA's divisions and district planning bureaus supervise and guide the national, district, and local planning committees, which are composed of various public and government representatives. National development outline plans are generally determined by the National Council for Planning and Construction, in accordance with

the 1965 Planning and Construction Law. Specialized planning issues are addressed by dedicated committees, such as the Infrastructure Planning Committee (VATAL) or the Subcommittee for Principle Planning Issues (VALNATA) (Figure 2).

In 2015, ministerial responsibility for the IPA was transferred from the Ministry of Interior to the Ministry of Finance (MoF). The MoF coordinates the National Planning Council in collaboration with representatives from several government ministries and representatives of the public. This structural change was preceded by legislation in 2014 designed to promote rapid housing development (the Law on Promoting Construction in Preferred Areas for Housing).

It should be noted that the Ministry of Health (MoH) received the status of a substitute member in the Committee for Planning and Construction of Preferred Areas for Housing (VATMAL), which was formed under this law. As such, the MoH representative does not have the power to vote on plans in preferred areas for housing, except when filling in for a representative of the Ministry of Agriculture and Rural Development (MoAg). In addition, new national guidelines for zoning were developed independently by "The Housing Cabinet," a temporary body that does not include the MoH or other health representatives.

Planning Committees in Israel and the Role of Ministry of Health (MoH) Representatives



← **Figure 2**
 Source:
 Israel Planning Authority⁽⁶⁾

Health Effects and Risk Assessment

The 1982 Building and Construction Law and Ministry of Environmental Protection (MoEP) regulations from 2003 require an Environmental Impact Assessment (EIA) for plans expected to significantly impact the environment - for example, plans for power plants, airports, sea ports, mining, and industrial development. The EIA is a comprehensive report on the estimated environmental effects of development projects. If the anticipated environmental effects are unacceptable, design measures or other relevant mitigation measures should be taken to reduce or prevent those effects. After the EIA is conducted, the MoEP provides recommendations for the project. The MoEP's EIA regulations do not explicitly require the assessment of the health implications of planning initiatives, but they do require the assessment of several health related issues, such as air pollution and exposure to hazardous materials. In 2015, several Knesset members tried to promote legislation requiring that planning processes include a Health Impact Assessment (HIA) - a broad assessment of the health impact of policies, plans and projects. There is still no progress on this subject.

In 2011, the MoH gave the IPA draft guidelines for conducting a Health Risk Assessment (HRA) - a quantitative assessment of risk from chemicals or air pollution; however, the guidelines were not implemented. Regardless of the legal status of these guidelines, representatives of the MoH, public committees or parliamentary committees ask for an HRA and recommendations in selected cases (Table 1). One significant example is Sde Barir, an area near Arad and Kseife where a new phosphate mine is planned. In 2014, an assessment of the health impact of this planning initiative was performed by an international expert. According to the assessment, an expected increase in PM_{2.5} could result in a significant increase in the associated burden of morbidity and mortality in the population living adjacent to the proposed mine. Based on this finding, the MoH recommended considering halting or significantly restricting mining plans due to their proximity to residential areas. It is important to note that no final decision has been made to date regarding phosphate mining in Sde Barir.

Selected Cases of Health Risk Assessments in Major Planning Initiatives in Israel

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Table 1

Planning Initiative	Location	Assessment Type	Result
Phosphate Mining	Sde Barir - Arad	Conducted by an international expert	<ul style="list-style-type: none"> • Estimated increase in morbidity burden and mortality attributed to PM exposure • IPA approved the mining plan in 2017 • An appeal against the mining plan was submitted to the Supreme Court
Quarry and Town Expansion	Elad	Assessment of respiratory disease incidence	<ul style="list-style-type: none"> • It was concluded that expansion would lead to higher rates of asthma • The expansion plan was cancelled
Increasing Power Plant Capacity	Haifa	Complex environmental and public health assessment	In progress
Landfill Site for Construction Waste	Jerusalem	Assessment of respiratory disease incidence	By request of the MoH, a local station for air pollution monitoring was established and is measuring PM concentrations and other air quality indices in the designated area. After the data are received, a decision will be made regarding the landfill site.

In 2015, the MoEP published the Guide to Environmental Planning, which addresses major topics in the field of health and environment, including air pollution, noise, radiation, recycling, green building, and climate-based planning. The document specifies the planning steps required to build new roads, including mapping the current populations and ongoing needs, examining environmental aspects such as national parks, open spaces, ecological corridors, and light pollution, and examining planning alternatives⁽³⁾. In 2013, the MoEP and Ministry of Education (MoEd) published draft guidelines for planning considerations regarding siting of schools in proximity to agricultural areas.

In recent years, numerous regulatory changes were implemented to allow denser housing development, most of which were conducted without an HIA. Two changes have potentially adverse public health effects:

- According to a decision by the National Planning and Building Council, the minimum distance between gas stations and residential areas was reduced from 40 to 20 meters.
- The planning guidelines for open public space per person was reduced from 25 m² to 5-10 m² and now includes street corners, wider sidewalks, and nature reserves adjacent to the city as part of the open public spaces. Similar changes were already made in designated open spaces within the domain of schools and day care facilities⁽⁷⁾.

Urban Planning

There are guidelines for shading playgrounds in kindergartens (25% of the area, according to the Ministry of Economy and Industry standard), schools (15% of the schoolyard, according to joint guidelines by the MoEd and MoH), and swimming pools (25% of the pool area). However, there are no regulations or binding guidelines for shading areas at the street level and in open public spaces, including in public playgrounds. The IPA is currently participating in efforts to draft shading guidelines, in collaboration with the MoH, the MoAg, and several municipalities.

Members of the “Forum 15”, an umbrella body of 15 leading local authorities, have adopted the Green Building Standard for all local planning initiatives, including residential, commercial, and public buildings. The Green Building standard (Israeli Standard 5281) is a voluntary standard for sustainable construction and housing. The standard consists of a detailed rating system to evaluate a building plan for its sustainability, or “greenness,” in a wide range of areas, such as energy, soil, water, materials, waste, transportation, health, and welfare⁽⁴⁾.

Renewable Energy

In 2015, the Israeli government submitted its greenhouse gas reduction targets to the secretariat of the UN Framework Convention on Climate Change (UNFCCC). Among the targets, Israel committed to an increase in renewable energy from the current rate of 2% to 17% of the total energy production by the year 2030.

Major efforts are underway in both solar and wind energy development, and in energy efficiency measures. The Ministry of Energy published a national plan for energy efficiency in 2016 for public review⁽⁵⁾. Nonetheless, there is still no legislation on renewable energy in Israel. The MoH and the MoEP published guidelines for buffers between residential areas and large wind turbines, as well as a requirement to conduct noise simulation.

Data on Planning Issues in Israel

Contaminated Land Remediation

During the years 2005-2017, soil contamination by petroleum, hazardous materials, and waste was

identified in an increasing number of sites. The MoEP ordered a survey to estimate the scope of contaminated land and the cost of remediation. The survey identified 700 sites with proven land contamination and an additional 23,100 sites with suspected past or present contamination. The majority of contaminated sites previously served as petroleum refinement and storage areas, gas stations, army bases, or defense industry sites. The estimated remediation cost was NIS 8.8 billion, with 20% of this cost targeting the contamination of soil used for petroleum storage and treatment. To date, there is no comprehensive legislation in Israel requiring an EIA and remediation before approval of construction on contaminated lands⁽⁹⁾.

Green Spaces

According to a survey conducted in 2014 by the Central Bureau of Statistics, 56% of Israelis are satisfied with the amount of green space such as parks in their residential areas. However, only 27% of the Jewish residents of Jerusalem and less than half of the residents in the Northern District were satisfied⁽²⁾.

Environmental Health and Transportation

Another critical problem is the expansion of existing neighborhoods and urban renewal projects without effective public transportation planning. In 2014, and again in 2016, an NGO (Adam Teva V'din - the Israel Union for Environmental Defense) and several Knesset members attempted to pass a bill requiring assessment and planning of public transportation prior to embarking on housing planning initiatives. This and several other bills addressing public transportation did not pass, mainly due to increasing pressure to reduce the cost of housing development.

Although the annual budget of the Ministry of Transportation (MoT) for bicycle paths is only NIS 19 million (which enables paving only 4 km), there is increasing awareness regarding the need for planning and paving such paths, especially in big cities with high socioeconomic ranking. In 2017, the MoT announced a NIS 620 million master plan to construct an intercity bicycle path connecting cities in central Israel. A survey conducted by the "Forum 15" localities in 2014-2015 showed that most of its member cities have master plans for paving bicycle paths. However, according to the survey, none of the cities has more than 50 km of paved bicycle paths except for Tel Aviv (which has 120 km of bike paths). Furthermore, the degree to which the paths are interconnected and serve as an effective means of transportation was not directly measured in the survey and thus riding paths in open spaces, outside the city, may artificially inflate the estimate.

Research on Health Aspects of Planning in Israel

- ♦ Researchers from the University of Haifa examined cancer incidence rates associated with residential proximity to the Kiryat Haim industrial zone in northern Israel, using different analytical techniques and adjusting for several potential confounders, such as road proximity, population density, smoking rates, and socio-demographic attributes. The researchers found that living near petroleum storage sites may present a significant cancer risk⁽¹⁰⁾.

- A study published in 2014 examined the association between proximity to green spaces and birth outcomes in Israel. The study, conducted by researchers from the University of Haifa, Tel Aviv University, Bar-Ilan University and Ben-Gurion University, in collaboration with the Barcelona Institute for Global Health (ISGLOBAL), analyzed the amount of green spaces and vegetation near the homes of approximately 40,000 pregnant women in the Tel Aviv area, and found a statistically significant increase in birth weight related to maternal proximity to green space. Stronger associations were observed among women of lower socioeconomic status⁽¹⁾.
- Researchers from Tel Aviv University and the Gertner Institute for Epidemiology and Health Policy Research, together with researchers from Germany and Canada, are studying the relationship between a green residential setting and mortality within ten years of coronary artery bypass surgery among heart patients in Israel. The study is also examining the connection between exposure to green residential settings and symptoms of depression and anxiety one year after bypass surgery.

Progress and Challenges

Planning processes require a complex balance between the expansion of residential areas and industrial zones, and the preservation of open spaces. Israeli regulation of land usage, planning, and development is governed by several bodies that represent competing public interests, and consequently, environmental health issues are often compromised. During the past decade, public protest over rising housing prices has pushed governments to ease regulatory constraints on construction and development. As a result of these changes in the planning landscape, the MoH faces considerable challenges in introducing environmental health considerations into national and local planning processes. Some progress has been made in mandating HRAs for existing environmental health issues and requiring HIAs in future planning policies.

Planning in Israel entails a number of health-related challenges:

- A major challenge for Israel in the coming years is to address the political pressure for rapid development, while minimizing environmental health risks and promoting planning that takes public health into consideration. In this context, it is critical for the MoH to receive voting rights on planning committees in Israel.
- The MoH guidelines for HIA have yet to be accepted by the IPA. There is also insufficient collaboration between the MoH and MoEP regarding the inclusion of the HIA within the EIA of large-scale projects that have potential health impacts. Planning projects are assessed individually, and there is no integrative assessment of multiple exposures.
- There has been a steady increase in MoH demands to conduct an HIA and associated HRAs in national planning initiatives. However, the extent to which the recommendations from these assessments are implemented in the planning processes depends on multiple socio-political factors.

- ♦ Urban planning for pedestrians and bicycle riders is gaining momentum, mainly in Tel Aviv, while less so in other cities where car-oriented planning and the resulting sedentary life style are still dominant. Greater involvement of both the MoEP and MoT in promoting planning and development of bicycle paths, and in providing incentives to local authorities, may result in greater progress. There is also a need for more efficient public transportation in Israel.
- ♦ Increasing public concern regarding plans for wind turbines in the vicinity of residential areas may become an obstacle to the government's efforts to develop renewable energy sources. The MoH is working with the MoEP to reassure the public regarding concerns that are not scientifically based, and, on the other hand, to introduce strict regulations to address potential health outcomes.
- ♦ The absence of comprehensive policy for sustainable means of reducing emissions of heat, radiation, and greenhouse gases in a highly urbanized country that is suffering from an increasingly arid climate requires urgent attention.
- ♦ Failure to address problems such as exposure to UV radiation in public spaces may have long-term impacts on the national burden of disease, including cancer. While progress has been made within the IPA in developing shading guidelines, the implementation of these guidelines will depend on collaboration between different governmental ministries and local authorities. To date, there is no requirement for shaded areas when planning open public spaces. Consequently, many open spaces, including playgrounds, lack sufficiently shaded areas.

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Vulnerable Populations

The term “vulnerable populations” has a broad and flexible definition in the context of environmental health and includes sub-populations that are potentially more vulnerable to the adverse health effects of environmental exposure compared to the general population. Increased vulnerability may be the result of intrinsic biological factors or extrinsic exposure-related factors. Intrinsic vulnerability factors include age, life stage (such as pregnancy), gender, ethnicity, and genetic polymorphisms. Extrinsic vulnerability factors include socioeconomic status (SES), health status, nutrition status, geographic proximity to sources of exposure, and various lifestyle choices.

The developing fetus, for example, is uniquely vulnerable to the effects of environmental exposures due to intrinsic biological factors. Individuals or subgroups with genetic polymorphisms may be vulnerable to environmental exposures because of differences in the way the body accumulates, distributes, and eliminates environmental chemicals.

Low SES individuals are more vulnerable to the adverse health effects of environmental exposure due to extrinsic factors, for example, higher smoking rates (compared to the general public) and the increased likelihood of living near hazardous waste sites, industrial facilities, and major roads. Lack of information, resources, and choices can exacerbate the vulnerability of low SES individuals. Individuals who are compromised nutritionally (e.g., diets lacking antioxidants and anti-inflammatory nutrients) may be more vulnerable to hazardous chemicals throughout their life. Refugees may be more vulnerable due to the lack of access to safe water and poor sanitation.

There is growing evidence that vulnerable populations bear a disproportionate burden of disease that is associated with environmental exposures. This chapter describes the policies, data, and research in Israel on populations that may be particularly vulnerable to environmental pollutants.

Policy and Regulations

Environmental health policies in Israel generally aim to protect vulnerable populations. Ambient air standards and drinking water standards are developed to be protective of the most vulnerable individuals, primarily children and pregnant women. Pesticide labels often include specific warnings or instructions regarding children, pregnant women, and other sensitive populations, such as the elderly and those with allergies or asthma. Most of the mandatory consumer product standards in Israel target products intended for babies and children, including toys, baby bottles, cribs and infant mattresses, and playground equipment. Additional mandatory standards in the process of being approved pertain to children’s eating utensils and jewelry (see the “Chemicals in Consumer Products” chapter). However, despite specific standards for children’s products, there is no comprehensive and dedicated regulatory framework in Israel for children’s products. Such regulatory frameworks exist in other developed countries in the world.

The public advisories issued by the Ministry of Environmental Protection (MoEP) and the Ministry of Health (MoH) on exposure to air pollution primarily address vulnerable populations, including people with heart or lung disease, the elderly, pregnant women, and children. While the general population is advised to avoid intensive physical activity outdoors when air pollution is exceptionally high, vulnerable groups are advised to avoid spending extended periods of time outdoors (Table 1)^(2,12). The MoH, in collaboration with other government ministries, is currently working to raise awareness among educators (school principals and directors of kindergartens and institutions operating under the auspices of the Ministry of Labor, Social Affairs and Social Services) regarding severe air pollution events and their health effects, and to improve the flow of information to and within the educational system during severe air pollution events.

Ministry of Environmental Protection and Ministry of Health Recommendations: How to Act Following an Advisory on Severe Air Pollution

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Table 1
 Source:
 Israel Ministry of
 Environmental
 Protection⁽²⁾

Air Pollution Category	Recommendations for the General Population	Recommendations for People with Heart or Lung Disease, the Elderly, Pregnant Women and Children
Good	None	None
Moderate	None	None
High	Reduce intensive physical activity* outdoors	Avoid intensive physical activity* outdoors
Very High	Avoid intensive physical activity* outdoors	Avoid being outdoors for an extended period of time, including walking, sports, biking, shopping in open markets, and gardening

* Examples of intensive physical activity: intensive biking, long uphill walking, jogging, and ball games.

The Israeli Climate Change Information Center (ICCIC), which publishes recommendations regarding the health aspects of climate change, places particular emphasis on vulnerable populations, such as the elderly. The MoH regularly publishes information leaflets and recommendations for the elderly regarding heat waves and cold spells^(14,15).

There are planning and construction processes that take into account the special vulnerability of various population groups that may be affected by certain aspects of the construction. For example, when Israel Railways proposed burying waste near Mesilat Zion, a community in the Jerusalem hills whose residents have a high incidence of asthma, the MoH demanded a Health Impact Assessment (HIA). The high background incidence of asthma and allergies in this community is apparently associated with genetic susceptibility among Jews with origins in Cochin, India. Similarly, in developing policy on Sde Barir, an area near Arad and Kseife where a new phosphate mine is planned, the MoH took into consideration the high background incidence of respiratory problems in the Arad population.

In recent years, the MoH has published advisories that focus on vulnerable populations:

- Dietary recommendations on arsenic consumption for infants and pregnant women;
- Recommendations on iodine consumption, with emphasis on pregnant women, breastfeeding women, women of reproductive age, and individuals with diets lacking in grains and milk products;
- Recommendations on the use of dental amalgam (containing mercury) to fill cavities in children, pregnant and breastfeeding women.

The Main Vulnerable Populations in Israel - Published Research and Data

The main populations in Israel with potential for increased sensitivity to environmental exposure are children and pregnant women; Arab populations, including Bedouins; people with chronic diseases and the elderly⁽²⁴⁾.

Children and Pregnant Women

The developing fetus is extremely vulnerable to environmental pollutants. The vital systems (e.g., the nervous and respiratory systems) and metabolic pathways in the fetus' body are still developing. Environmental exposure at such an early stage of life prolongs the period in which chronic illness may develop as a result of exposure.

Children tend to spend more time outdoors than adults and have unique behaviors (e.g. mouthing behavior) that may increase exposure to environmental pollutants. It is important to note that the Israeli population is relatively young and children make up over 30% of the population. The fertility rate is relatively high in Israel (an average of 3.13 children for both Jewish and Arab women)⁽¹¹⁾.

Several studies on the adverse health effects of ambient air pollution have focused on children and pregnant women (see the "Ambient Air Quality" chapter). Additional research on pregnant women includes, for example, a study published in 2017 on iodine insufficiency in pregnant women in Israel⁽²³⁾ and a study on the impact of proximity to green spaces on birth outcomes⁽¹⁾.

A study conducted by researchers from the Hebrew University's Center of Excellence in Agriculture and Environmental Health and the MoH showed that children have higher potential exposure than the general population to various types of pesticides, and that exposure of children to ten pesticides exceeded the Acceptable Daily Intake (ADI)⁽⁷⁾.

Arab Population

The Arab population in Israel, which makes up 20.8% of the total population, is likely to be more exposed to tobacco smoke. Over 40% of Arab men in Israel smoke, and self-reported exposure to environmental tobacco smoke (ETS) is higher among Arabs than among Jews in Israel. According to data published by the MoH in 2014, over 50% of Arab infants are exposed to ETS, based on maternal report⁽¹⁰⁾.

The Bedouins in southern Israel are considered a vulnerable population due to their low SES, high smoking rate, aspects of their traditional lifestyle, and the lack of infrastructure in unrecognized villages. In addition, Bedouin society is characterized by high fertility rates and this increases the relative proportion of vulnerable populations such as infants, children, and pregnant women. According to a 2014 publication on health and morbidity among the pediatric Bedouin population, 39% of Bedouins in southern Israel live in unrecognized villages, where residents live in prefabricated houses, shacks, or tents without regulated provision of water and electricity. Gas stoves or open fires are used for cooking and heating. Due to these living conditions, Bedouins in southern Israel are particularly exposed to indoor air pollution and the effects of extreme weather conditions, such as heat waves⁽²⁵⁾.

Researchers at the University of Haifa and the Baruch Padeh Medical Center, Poriya published a study in 2016 on the association between second-hand smoking and coronary heart disease (CHD) among Arab women in Israel. The researchers point out that exposure to domestic second-hand smoking is independently associated with CHD in Arab women, with a strong dose-response relationship⁽³⁾.

According to a study published in 2011 by researchers from the MoH, the Hebrew University of Jerusalem, Bar-Ilan University and Ben-Gurion University (BGU), several polycyclic aromatic hydrocarbons (PAHs) were found in urine samples of Arabs and Druze at a statistically significant higher level than among Jews. Among non-smoking Arabs and Druze, several PAHs were found at higher levels among those consuming grilled food at least once a month. However, urinary bisphenol A (BPA) levels were lower among Arabs and Druze than among Jews⁽²⁰⁾.

A study published in 2017 by researchers from the Hebrew University of Jerusalem and Al-Quds University in East Jerusalem found different risk factors for B-cell non-Hodgkin lymphoma - those found among Palestinian Arabs are different from those found among Jews. The researchers concluded that effect modification by ethnicity raises the possibility of gene-environment interactions, but also may reflect differences in diet, cultural habits, SES, housing conditions, medical services, exposure to infections in early life, or other factors⁽¹⁷⁾.

Researchers at BGU, the Sheba Medical Center, and the MoH examined pregnant Bedouin women in southern Israel and found higher urinary concentrations of aluminum in women residing within 10 km of a local industrial zone (Neot Hovav), or who reported cooking or heating on a wood-burning stove or an open fire⁽¹⁶⁾.

Researchers at BGU studied exposure of pregnant Bedouin women to air pollution, high temperatures, and hazards in the home environment and effects on birth weight. The researchers found that exposure to ozone and high temperatures in the third trimester, and waste in the home environment, were associated with low birth weight among this population. It is worth noting that while exposure to high temperatures and ozone were associated with low birth weight, the contribution of poor household environment indicators to low birth weight was substantially higher⁽²⁷⁾.

Researchers at BGU, the MoH, and Soroka Medical Center studied the association between exposure to nitrogen dioxide (NO₂) and congenital malformations in 1,024 pregnant Bedouin women in southern Israel. Maternal NO₂ exposure during the first trimester (concentrations of more than 8.6 ppb) was significantly associated with minor congenital malformations (CMs). Major CMs were independently associated with using an open fire for heating⁽¹⁸⁾.

Researchers from BGU and the Soroka Medical Center found that maternal exposure to fine particulate matter (PM_{2.5}) presents a risk factor for lower respiratory tract infection among Bedouin infants during their first year of life⁽⁸⁾.

According to a 2013 report by Beterem - Safe Kids Israel organization on childhood pesticide poisoning in Israel in 2008-2013, most of the poisonings occurred among Arab children, particularly Bedouins. The data indicate that in most cases, the incidents occurred in or near the home⁽⁶⁾.

Individuals with Chronic Disease and the Elderly

Individuals with pre-existing diseases, such as asthma and diabetes, may be more vulnerable to the effects of environmental pollutants. The elderly may be more sensitive to environmental pollutants because of deterioration of their physiologic, biochemical and immunologic parameters. Increased oxidative stress weakens antioxidant defense. It should be noted that the elderly are particularly vulnerable to heat waves, extreme weather events, and other effects of climate change.

Studies conducted in Israel in recent years have examined the impact of environmental contaminants on populations with compromised health status. One study published in 2010 by researchers from the University of Haifa measured the effects of exposure to nitrogen oxides (NO_x) and sulfur dioxide (SO₂) on the development of pulmonary function in children in three groups (a) healthy children; (b) children with respiratory symptoms (wheezing and coughing); (c) children with asthma or spastic bronchitis. Exposure to both indoor and ambient air pollution had the strongest effect on children with respiratory symptoms⁽²⁹⁾.

A study published in 2013 by researchers from Tel Aviv University (TAU) focused on the association between chronic exposure to PM_{2.5} and frailty. The researchers found an association between exposure to PM_{2.5} and incidence of frailty, an association that indicates a potential intermediary between air pollution and post-myocardial infarction outcomes⁽²¹⁾.

Research on Additional Vulnerability Factors

In addition to the vulnerable populations described above, there is evidence that individuals with genetic susceptibility factors, low SES groups, refugees, and communities living in proximity to sources of pollution may be more vulnerable than others to environmental threats.

Genetic Susceptibility

A study published in 2009 examined the impact of different environments on the prevalence of asthma and allergies in a genetically homogeneous population that immigrated to Israel from Cochin, India, fifty years ago. The study found that the overall prevalence of asthma in Cochin Jews was 23.7%; and of allergies, 29.5%. The rate of asthma and/or allergies among Cochins living in the Jerusalem hills was statistically significantly higher than in a control group of non-Cochin Jews living in the same region. The rates of asthma and allergies among Cochin Jews living in the Jerusalem hills were statistically significantly higher than these rates among Cochin Jews living in southern Israel⁽²⁶⁾.

A study published in 2015 showed that paroxonase (PON1) lactonase activity is significantly lower among Palestinians in comparison to Jews living in Jerusalem, while the PON1 functional genotype distribution is generally similar. The results suggest that the lower PON1 lactonase activity may explain part of the increased cardiovascular risk among Palestinians. It is unknown how these differences may affect susceptibility to environmental pollutants, including organophosphate (OP) pesticides⁽⁹⁾.

Socioeconomic Status

Low SES (characterized by higher rates of unemployment, lower income, and lower educational level in comparison to the general population) is significantly associated with the current percentage of smokers among men, but not among women in Israel. Based on findings published in 2013 by researchers from the Hadassah Medical Center and the MoH, exposure to ETS was higher among those of lower educational level. On the other hand, exposure to BPA and OP pesticides was higher among individuals with higher SES and a higher educational level^(4,5,19).

A study on birth outcomes and proximity to green spaces, conducted by researchers from the University of Haifa, TAU, Bar-Ilan University, and BGU, in collaboration with the Barcelona Institute for Global Health (ISGLOBAL), found stronger associations between proximity to green spaces and low birth weight among lower SES women⁽¹⁾.

Residence in Proximity to Agricultural Fields, Industrial Zones, and Haifa Bay

A study conducted in 2015 by researchers from BGU and TAU found a higher incidence of Parkinson's disease (PD) among Jewish populations living in proximity to large cultivated agricultural fields in the Negev, based on data collected between the years 2000 and 2012. The researchers found that proximity to the field and its size contributed to the risk of PD. Since it is estimated that 33% of the population in Israel lives within 200 meters of agricultural fields or orchards, this is a sizable, potentially vulnerable group⁽²⁸⁾.

In 2015, researchers from the Hebrew University of Jerusalem, BGU, TAU, Clalit Health Services, and the Rabin Medical Center published a study in which they examined whether living near hazardous industrial parks is likely to increase the risk of pediatric hospitalization for respiratory diseases. Infants under the age of one who live within 10 km of the Neot Hovav Industrial Park were found to be at increased risk of hospitalization due to respiratory problems in comparison to children living more than 20 km from the industrial zone⁽²²⁾.

Studies conducted in the Haifa Bay indicate an increased risk of lung cancer and non-Hodgkin's lymphoma, as well as cardiovascular and respiratory diseases, compared to other geographical areas in Israel⁽¹³⁾.

Ongoing Research

There are currently several longitudinal birth cohort studies underway in Israel that focus on the adverse effects of exposure to environmental pollutants on pregnant women and on the developing fetus (see the "Biomonitoring" chapter).

As part of the 2015-2016 National Health and Nutrition Survey (Rav-MABAT), urine samples were collected from 100 children ages 4-12 (49% male and 51% female). Jewish children comprise 59% of the sample, and Arab and Druze children 41%; children from both urban and rural areas were sampled in both groups. As part of the study, the urine samples are being tested for the presence of cotinine (a nicotine metabolite) and OP pesticides. Arab children were purposely oversampled in order to examine the hypothesis that Arab children are more exposed to ETS due to high smoking rates among Arab men in Israel.

Progress and Challenges

In 2016, the government decided to develop a National Plan for Health and the Environment. The plan places special emphasis on vulnerable populations, especially children, pregnant women, the elderly, and those with chronic diseases. One of the challenges in developing the national plan will be to identify additional vulnerable groups in Israel and tailor goals and specific targets to the various vulnerable groups.

Israel's environmental health laws and policies apply within the state's geographic borders. However, Israel is surrounded by countries and territories with less regulatory oversight of industrial pollution, pesticide use, and consumer products. A study published in 2014 showed that 42% of plastic toys sold in the Palestinian market contained concentrations of lead that exceed the maximum concentrations permitted in many countries in the world. The transfer of goods to Israel from bordering territories, including the West Bank and East Jerusalem, may place vulnerable populations in Israel at higher risk.

It is unknown which populations in Israel are most vulnerable to emerging environmental health risks. For example, it is unclear how different diets and other vulnerability factors affect the absorption and retention of magnesium and iodide from drinking water. There is evidence that genetic polymorphisms affect vulnerability to heavy metals, trihalomethanes, OP pesticides, and other environmental contaminants, but there is little data on the prevalence of such genetic polymorphisms in Israel's population. Further research on genetic polymorphisms and other vulnerability predictors will help identify these vulnerable populations.

Although government ministries (including the MoH and the MoEP) publish recommendations specific to vulnerable populations, it is not clear to what extent such recommendations are accessible to the vulnerable populations themselves, in terms of language and media. Collaboration between government ministries and civil society organizations working on behalf of vulnerable populations may improve the flow of information regarding environmental hazards and their prevention, and may promote mechanisms for public participation.

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Environmental Health Indicators and Trends

There is clear scientific evidence that environmental risk factors affect human health and are significant contributors to the global burden of disease (GBD). Based on global estimates, the leading environmental risk factors include ambient air pollution from particulate matter (PM), indoor air pollution, and environmental tobacco smoke (ETS)⁽³⁾. It is estimated that 7 million premature deaths globally each year (over 10% of deaths worldwide) are attributable to the combined effects of ambient and indoor air pollution. Exposure to ambient air pollution contributes to the growing global burden of chronic obstructive pulmonary disease (COPD) and other respiratory and cardiovascular diseases. According to estimates, exposure to ETS caused 603,000 deaths globally in 2004 - about 1% of worldwide mortality, as well as lower respiratory infections and asthma in children⁽¹⁴⁾. The GBD in 2004 from exposure to lead was 143,000 deaths and 600,000 new cases of children with intellectual disabilities⁽¹⁹⁾. Exposure to additional environmental chemicals, including methylmercury, arsenic, and pesticides, also contributes to the GBD. An analysis of data from six European countries, published in 2014, indicates that about 3%-7% of the annual burden of disease in the participating countries was associated with environmental risk factors - primarily ETS, fine particulate pollution (PM_{2.5}), and pollution from traffic, noise, and radon⁽⁶⁾. Exposure to endocrine-disrupting chemicals (EDCs), phthalates, bisphenol A (BPA), polybrominated diphenyl ethers (PBDEs), organochlorines, and organophosphate pesticides also contributes to the GBD and is associated with a decline in IQ, reduced fertility, autism, attention deficit hyperactivity disorder (ADHD), obesity, diabetes, and testicular cancer⁽¹⁾.

In 2015, exposure to air pollution was ranked in the top ten contributors to the burden of disease in Israel by the Global Burden of Disease Study. There are an estimated 2,500 premature deaths a year linked to exposure to air pollution⁽⁵⁾, as well as 780 deaths attributed to exposure to ETS⁽⁴⁾. The burden of disease due to exposure to pesticides, EDCs, heavy metals, and other environmental exposures has not been analyzed to date.

Environmental health indicators, based on proven cause-effect relationships, serve as important tools for identifying potential risks to human health and for policymaking. Environmental health indicators are particularly important for:

- ♦ Monitoring trends in environmental exposures;
- ♦ Monitoring trends in health outcomes linked to environmental hazards and exposures;
- ♦ Comparing countries in terms of environmental health status in order to target action and allocate resources;
- ♦ Monitoring the effectiveness of policies and other interventions on environment and health;
- ♦ Raising awareness about environmental health issues.

Data Sources and Availability

A wealth of data in Israel is potentially available for developing environmental health indicators. Israel is unique in that each citizen has an ID number that can be used to link various registries. Every citizen has national health insurance and medical records that are stored electronically by health maintenance organizations (HMOs) for many years. In addition, there are several national databases and registries:

- ♦ The 1940 Public Health Ordinance requires reporting for selected diseases and health outcomes, including cancer, birth defects, and selected infectious diseases. There is also a perinatal registry that includes data on low birth weight. The National Cancer Registry at the Ministry of Health (MoH) is considered 97% reliable with respect to data on solid tumors, and it has consistently maintained a high level of coverage since its inception.
- ♦ The Israel Center for Disease Control manages registries on type 1 diabetes in children ages 0-17, based on outpatient clinic data, as well as on diabetes in all age groups, based on HMO data. There are additional registries on end-stage renal disease and kidney transplants, and cardiac surgeries. The MoH's National Cerebrovascular Transient Ischemic Attack (TIA) Registry is based on hospitalization data. Statistical data on fertility treatments in Israel have been collected since 1990.
- ♦ The MoH established a database on causes of death and maintains databases on emergency room visits and hospitalizations. This hospitalization database includes information on more than 90% of all hospitalizations throughout the country - demographic information, hospital admission and discharge dates, as well as all information on patient diagnoses.
- ♦ Data on various chronic diseases in Israel, including asthma, type 2 diabetes, stroke, and cardiovascular disease, are available from national surveys (Knowledge, Attitudes, and Practices Survey [KAP], Israel National Health Interview Survey [INHIS], Acute Coronary Syndrome Israeli Survey [ACSIS], National Acute Stroke Israeli Survey [NASIS]). In addition, data on exposure to ETS are collected in these surveys.
- ♦ Since 1967, data are available on the health status of adolescents (age 17), based on the mandatory examination of candidates for military enlistment. This includes diagnosis and assessment of the severity of asthma cases, based on a comprehensive medical evaluation. This database does not include certain segments of the population, such as subgroups that are not recruited for military service.
- ♦ The Israeli National Insurance Institute (INII), a government organization responsible for the social security of Israel's residents, collects data on autism and other cognitive developmental disorders.

- The National Program for Quality Indicators in Community Healthcare (QICH) was launched in 2004 to provide policymakers and consumers with information on the quality of community healthcare in Israel. The QICH publishes data on 28 quality indicators, including asthma, cancer screening, cardiovascular health, pediatric health, diabetes, and immunization in the elderly population. This data can be analyzed by age, gender, and socioeconomic status in order to identify at-risk populations.

Candidate Indicators for Environmental Health in Israel

In 2015, the MoH developed a list of candidate indicators for environmental health in Israel. The list is based primarily on indicators identified by the World Health Organization (WHO), United States Centers for Disease Control and Prevention (CDC), and WHO/Europe's Environment and Health Information System (ENHIS). Table 1 presents selected indicators that are uniquely relevant to environmental health in Israel, and the availability of the data. These indicators include exposure indicators, chronic disease indicators, climate change indicators, and early childhood health indicators.

Candidate Indicators for Environmental Health and Data Availability in Israel

	Indicator	Data Availability in Israel	Most Recent Data Available
Exposure Indicators	Lead in drinking water (tap)	MoH survey	2011 Additional survey planned
	Exposure to indoor air pollutants in school	NA	Survey planned
	Percentage of infants / children exposed to ETS	MoH survey	2014
	Intake of heavy metals in food among adults	NA	-
	Lead levels in children's blood	Academic research	1998-2000
	Percentage of adult population with urinary dialkyl phosphate above quantification level	MoH research	2011
Chronic Disease Indicators	Incidence of certain types of cancer, including childhood leukemia	MoH Cancer Registry	2014
	Asthma hospitalizations	MoH data on hospitalizations	Data collected continuously; updated data last published in 2008
Climate Change Indicators	Morbidity from vector-borne disease	MoH (mandatory reporting from physicians and laboratories)	2016
	Heat stress hospitalizations	NA	-
Early Childhood Health Indicators	Prevalence of certain congenital anomalies	MoH registry of congenital anomalies	2014
	Number of poisonings reported annually among children under 5	MoH, ER visits (under-reporting)	2015
	Prevalence of asthma and allergies in children	MoH survey	2008 (asthma in children ages 13-15)

←
Table 1
Source:
Israel Ministry
of Health

Available Data on Chronic Diseases and Conditions in Israel

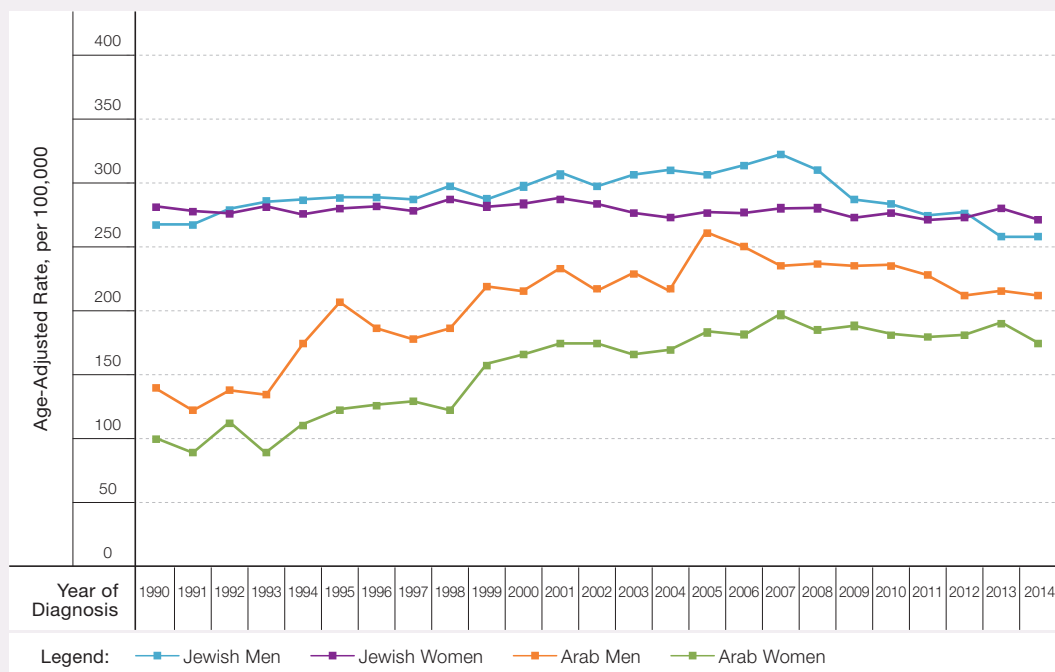
Cancer

Environmental and occupational risk factors have been linked to many types of cancer, primarily lung cancer, leukemia, mesothelioma, and melanoma. Recent evidence from a study on new immigrants and the risk of Hodgkin's lymphoma suggest that there may be an environmental component in the etiology of the disease, possibly due to preconception exposure, prenatal exposure, or exposure in early stages of life to changes in lifestyle and environment, and the interaction between this exposure and susceptibility genes⁽¹³⁾.

In 2014, the most common types of cancer among Israeli men were prostate cancer (in Jews) and lung cancer (in Arabs). Among women, breast cancer was the most common in both Jews and Arabs⁽¹¹⁾. There has been a significant decrease in the incidence of invasive cancer (all sites) in Jewish men since 2008 and in Jewish women since 1990 (Figure 1). In the Arab population, there has been a decrease in the incidence of cancer among Arab men since 2006; among women, the rate has remained stable since 2006. Compared to other Organization for Economic Co-operation and Development (OECD) countries, Israel has higher-than-average cancer incidence rates; on the other hand, mortality rates from cancer are lower than the OECD average.

Age-Adjusted Rates of Cancer in Israel, by Population Groups and Gender, 1990-2014

→
Figure 1
Source:
Israel Ministry of
Health⁽⁶⁾



Asthma

Asthma development and exacerbation can be triggered by exposure to a variety of indoor and outdoor environmental factors, including PM, ozone, ETS, dust mites, mold, and allergens.

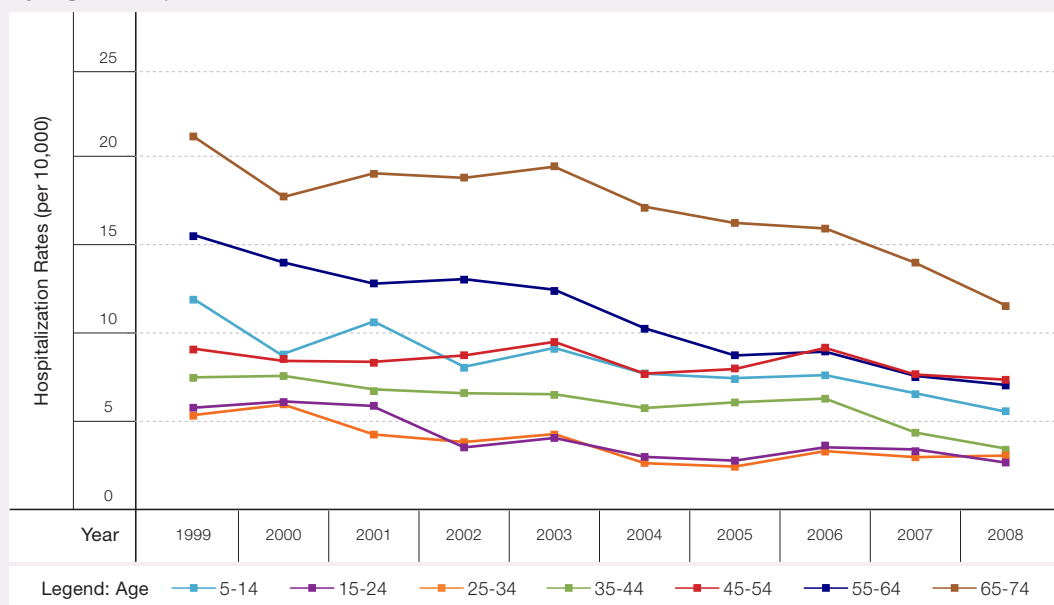
Based on QICH data, the incidence of chronic asthma among people ages 5-44 was 0.8% in 2015⁽¹⁷⁾. According to data published in 2017, drawn from an analysis of a computerized database of Clalit Health Services (the largest HMO in Israel), adult asthma prevalence in 2014 was 5.7%⁽¹⁸⁾. According to data from the 2013-2015 INHIS, 7.4% of the adult population reported having asthma (an increase from 5.8% in the previous survey in 2007-2010)⁽⁹⁾. The discrepancy in estimates apparently stems from the differences in data collection methodology (self-reporting versus data based on medical records) and from differences in the type of asthma included in the estimate.

The most recent data on asthma prevalence in children is from a survey conducted by the Israel Center for Disease Control in 2008. According to that survey (based on self-report), the prevalence of asthma among children ages 13-15 was 7.2% of Jewish children and 7.0% of Arab children. Asthma rates among Jewish students have remained stable since 1997. In the Arab, Bedouin and Druze populations, a steep rise in asthma rates has been observed⁽¹⁰⁾.

In a study on the prevalence of asthma in 17-year old boys eligible for army service, lifetime asthma prevalence decreased steadily, from 9.7% in 1999 to 8.1% in 2008. The largest decrease in this age group was of moderate-to-severe persistent asthma (down from 0.9% in 1999 to 0.4% in 2008)⁽²⁾.

The hospitalization rate due to asthma among people of ages 5-74 decreased steadily between 1999 and 2008, from 13.02 to 7.59 per 10,000 individuals - a reduction of 42%. There was a significant decrease in the hospitalization rate in all age groups (Figure 2). This decrease is likely attributable to the decrease in asthma prevalence and to improved asthma care in primary care settings.

Annual Hospitalization Rates for Asthma (per 10,000), Ages 5-74, by Age Group, 1999-2008



← Figure 2
Source:
Cohen et al., 2015⁽²⁾

The asthma mortality rate in Israel dropped by 41% during this period (1999-2008), from 2.1 to 1.4 per 100,000 population. The researchers suggest that this decline may be attributed to reduced exposure to tobacco smoke (less smoking and ETS in public places as a result of legislation and information campaigns), increased use of corticosteroids, and decreases in NO_x, NO₂, and SO₂ emissions and in annual grass pollen counts.

In 2016, the MoH started a joint project with Clalit Health Services, an HMO that serves over 50% of the Israeli public. The project includes collection of data on the incidence of asthma among adults and children by districts, and in relation to various environmental hazards.

Cardiovascular Disease

Cardiovascular diseases are associated with exposure to air pollution, heavy metals such as lead, and ETS. Based on data from the 2013-2015 INHIS, 4.7% of the adult population reported having a cardiac condition, including myocardial infarction, chest tightness, and heart failure.

Obesity

Obesity is defined as a body mass index (body weight divided by the square of body height [kg/m²]) of 30 or more. While the major risk factors for obesity are generally considered behavioral (high-calorie diets combined with a sedentary lifestyle), the risk of obesity is also related to genetic and environmental factors. There is increasing evidence that early-life exposure to environmental chemicals plays a significant role in the global obesity epidemic.

According to data from the 2013-2015 INHIS, 37.6% of the adult population is overweight (a body mass index of 25.0-29.9) and 17.8% is obese. Similar data was published in the 2013 KAP survey report and in QICH findings from 2015. MoH data from 2015-2016 indicate that 1 in 4 children in grades 7-12 is overweight or obese, with the highest rates among Arab boys⁽¹⁶⁾.

Diabetes

Exposure to EDCs has been linked to type 2 diabetes and pre-diabetic disturbances. For example, exposure to high levels of dioxins has been associated with an increased risk of diabetes mellitus or altered glucose metabolism. There is evidence that the prevalence of autoimmune disorders, including type 1 diabetes, is increasing and that environmental factors may play a role in this increase.

According to data from the 2013-2015 INHIS, 8.4% of the adult population reported having diabetes⁽⁹⁾. Data published in 2014 by Clalit Health Services show that from 2004 to 2012, there was a consistent but gradually diminishing upward trend in the prevalence of diabetes, with a cumulative increase of 34.3% over nine years. There were 343,554 diabetes cases in 2012 (14.4%) among the 2,379,712 HMO members, ages 26 and up⁽¹²⁾.

An Israel Center for Disease Control report on diabetes indicates that among children of ages 0-17, the incidence rate of type 1 diabetes in 2015 was 13.8 per 100,000. Between 1997 and 2015, there was a 43.6% increase in the incidence of type 1 diabetes⁽⁷⁾.

Autism

Several studies have found associations between the risk of autism spectrum disorder (ASD) and environmental exposures, including exposure to air pollution, pesticides, and heavy metals during pregnancy, but more research is required in order to understand the etiology of autism. In 2011, the cumulative incidence of ASD among the total population of 8-year-olds born in Israel was 0.49% (1 in 203 children). The incidence of ASD increased tenfold (from 0.049% to 0.49%) between 2000 and 2011⁽¹⁵⁾. Changes in diagnostic methods can explain part, but not all, of this increase.

Major Challenges

Despite the wealth of data collected from national registries and surveys, from candidates for military enlistment, and in electronic databases collected by Israel's four HMOs, there are significant data gaps in candidate indicators of environmental health in Israel. Data on many health indicators is not available (such as asthma prevalence in children 0-5 and heat stress hospitalizations), while data on other health indicators is available but reflects severe under-reporting (for example, poisonings in children). There is no data available on several exposure indicators (such as indoor air quality in schools, heavy metal intake in adults from food). The available data on many indicators are sporadic or not up-to-date (for example, asthma hospitalizations). Delays in analyzing and reporting data from registries pose another obstacle.

Despite reports on the increasing prevalence of diseases and conditions linked to environmental factors, such as type 1 diabetes, autism, ADHD, and obesity, there are few published studies based on a national analysis of the link between environmental exposures and health outcomes in Israel. HMO databases are an important potential resource for environmental health data and research. These databases include data on doctor visits, diagnoses, laboratory tests, subscribed medications, and purchased medications. The population treated at HMOs is stable in size, and there is standardized data reporting in computerized medical records used across all care settings within the HMOs. This enables consistency and completeness of the data, and makes it possible to track trends in diseases. Several HMOs have conducted large studies on national trends in diseases (such as asthma and diabetes) and have developed methods to study the long-term effects of medical exposures (such as MRI). These methodologies have not yet been applied to study environmental health trends and risk factors. Legal and ethical problems impede the use of computerized databases at HMOs to examine and analyze links between health and the environment. The lack of access to such health databases and registries by researchers poses an ongoing challenge.

The compulsory health examination that most Israelis undergo at age 17 is a potentially rich source of data for identifying environmental health trends (for example, asthma prevalence) and for research on associations between early life exposures and diseases in later life. In recent years, this data source is being used to examine associations between air pollution and

adverse health outcomes, including cancer and asthma. However, there are many obstacles - and major challenges - involved in working with this data source, primarily related to privacy and ethical issues.

There is a clear need for increased cooperation among the different government entities that collect health and environmental data and the HMOs. Making the collected data on environmental factors and health endpoints accessible - to researchers, policymakers, and the wider public, in a timely fashion - continues to be a major challenge.

The MoH launched the “Psifas” program to collect health data from volunteers. The program involves collecting questionnaires, genetic information, and data from biosensors, and establishing a research database. This database may also have potential use for environmental health research, including research on gene-environment interactions.

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Conclusions and Recommendations

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Environment and Health in Israel 2017 demonstrates not only the overall positive improvements in environmental health in Israel through policy, legislation, and research, but also shows advances that have occurred since the 2014 report, and opportunities for further advancements. In fact, there has been impressive progress in many areas since 2014, although all of the specific recommendations of the 2014 report are still relevant. One of the most impressive areas of progress is the increasing political commitment to work across ministries on environmental health issues, e.g., work on a National Plan on Environmental Health. Another is the establishment of several birth cohorts, which will provide an opportunity for longitudinal follow-up of both the mothers and their children in the coming years. New policies have also been established to eliminate environmental tobacco smoke in schools, and phase out many organophosphate and carbamate pesticides. It is hoped that the enforcement of these policies will match up to the potential for improved health due to a reduction in exposure and risk.

In the current international environment, as well as in Israel, understanding the economic impact of adverse effects of the environment on human health is a necessity. It is essential for cost/benefit and risk/benefit analysis. Studies done in the EU as well as in the United States have clearly demonstrated the huge financial benefit of controlling air pollution and the extreme costs associated with health care due to exposure to metals such as lead, pesticides such as chlorpyrifos, and endocrine disruptors such as BPA and phthalates. This field needs to be studied in Israel, as well as in the rest of the developed world.

Much of the focus on air pollution in Israel continues to be on ambient air pollution. While outdoor air contamination continues to be higher than desired, there is still much too little attention being paid to indoor air pollution. This is problematic as most people, even in Israel, spend the majority of their waking hours, as well as sleep, indoors. This is even more exaggerated when considering the elderly, a highly susceptible population. Air pollution levels indoors exceed those outdoors, and there are additional contaminants which need to be considered such as radon, volatiles from household cleaners and personal care products, and contaminants released into dust which can lead to inhalation, dermal, and oral exposure. Dust contamination is of special concern for infants and young children who spend much of their time on or near the floor and put everything into their mouths. We have known for decades about the problem of lead from paints in house dust, but we now know that flame retardants, endocrine disruptors, and even household pesticides are present in dust and are a significant source of human exposure.

Ambient air pollution remains a concern in Israel. While overall air pollution is certainly better than in some developing countries, the levels of ozone, PM_{2.5}, PM₁₀, SO₂, and NO_x are still too high, especially for susceptible populations such as young children and the elderly. Although the PM_{2.5} levels have decreased, given the increase in population, the overall burden of disease has continued to increase. It will be important to address where schools, nursing homes, and all housing units are located in respect to major highways and areas of high traffic congestion in order to reduce population health effects. So while traffic is a known source of air pollution, it is important to understand where other sources exist in order to control pollution and reduce adverse effects in the population.

A relatively new source of air pollution is exhaust from electronic cigarettes. Volatilization of the solvent as well as the nicotine can lead to significant second-hand smoke from e-cigarettes. It is important to realize that e-cigarettes are a drug delivery device, and that nicotine, which is highly addictive, is also a potent developmental toxicant, and a possible carcinogen in its own right. There should be policy developed to restrict their use and control exposure.

Water is a precious resource, essential in a desert country such as Israel which is an international leader in the use of desalinated water for drinking and treated wastewater for agriculture. However, not enough is being done to ascertain what is in the desalinated or recycled water, and what may be the potential for adverse health effects. When dealing with desalinated water, it is not only what is in the water, but what has been removed during the removal of salt, such as critical minerals. The presence of contaminants in recycled water remains a concern as some pharmaceuticals and personal care products have been found to contain these chemicals. Many of these are NOT removed by carbon filtration. The same is true of unregulated pollutants such as the per- and polyfluorinated alkyl substances (PFAS), of which the best known examples are PFOS and PFOA. This broad class of chemicals is used in non-stick cooking, water and stain repellency, as flame retardants, in cooking pans and utensils, and many other uses. They have been found as contaminants in many drinking water supplies, in food containers, and in

people. To date, little is known about their occurrence and sources in Israel, but as a developed country, contamination of drinking water is likely. Since Israel is a leading country in the use of treated wastewater, the presence of drugs in wastewater and possible health impacts also need to continue to be examined. Critical minerals and elements need to be at appropriate levels. The data demonstrating iodine deficiency in pregnant women is very concerning and supports the Ministry of Health's recommendations that table salt be fortified with iodine. In addition, there is evidence that the levels of magnesium in drinking water may be too low.

With the exception of 2016, since 2014 there has been an increase in the percentage of crops with no detectable pesticide residue. This is a positive trend that will hopefully resume in 2017. There are many opportunities for improvement, as much of the apple and melon crops have pesticides which exceed the Maximum Residue Level. This is of great concern as pesticide risk assessments in Israel are still based upon the central estimates of exposure, not the upper 95th percentile. Risk assessment, which is based on both exposure and hazard, needs to take into account not only the most heavily exposed but also the most vulnerable, such as the elderly, the infant, and the pregnant woman. Israel needs comprehensive legislation on pesticide registration which accounts for differential susceptibility.

Food contaminants range from unregulated chemicals to pesticide residues, compounds in consumer products, and naturally occurring chemicals. Everything in moderation is common sense, and the recommendation that pregnant women and infants consume a variety of cereals is appropriate. There needs to be a comprehensive survey of what is present in Israeli food. At this time, there are no measurements of flame retardants or phenols, such as BPA. Fish consumption, which should be strongly encouraged, may be problematic in areas where there are high levels of contamination with methyl mercury, such as found in Acre. Fishing advisories are essential in such situations, and should be considered if high levels of persistent organic pollutants such as organochlorine pesticides, PCBs, or dioxins are found. Even if contamination is relatively low, a database which estimates food consumption patterns is essential to enable exposure and risk assessment in sensitive populations such as children and pregnant women. While the Ministry of Health has plans to do this, it has not yet implemented such efforts.

Chemicals in consumer products migrate into dust, air, food, and water. Unless the compounds are physically bound to matrix, they will escape over time and contaminate the environment. This has been well studied with lead migrating from paint. And there is no safe level of lead, so there is a need to ban lead in paint, as well as in other products for babies and children. The Ministry of Economy should give greater consideration to public health protection and support the Ministry of Health in developing health protective standards for all chemicals of concern and adopt these standards in a timely fashion.

While it is essential to both understand and address the sources of environmental pollution, the real concern is where and how pollution gets into people. A statistically-based sampling of the Israeli population should be conducted every two to three years in which chemicals are measured

in accessible body fluids such as blood, urine, and breast milk. Biomonitoring in Israel has shown the presence of high urinary levels of organophosphate metabolites, indicating exposure to these toxic pesticides in the general population. Levels of dioxin-like chemicals and PCBs have also been found to exceed a safe level in breast milk. However, a formal government program is essential to obtain this kind of information for the entire population to allow protective measures to be taken. A national birth cohort or a large precision medicine cohort should be recruited and followed for at least 20 years in order to understand health trends in the population, including issues such as declining sperm quality and quantity, timing of puberty, and incidence of endometriosis and polycystic ovary syndrome. This would also allow success stories of environmental regulation to be observed in real time.

The greatest threat to global health in the 21st century is climate change. We are already seeing more extreme weather events, changes in vector distribution, and growing food insecurity. This will only increase as the overall global temperature continues to rise. Heat waves kill people, and both mitigation and adaptation must be pursued to maintain the health of the entire population, including vulnerable populations. Israel is a small country and in order to reduce air pollution leading to global warming, more efficient public transportation needs to be developed as does cleaner sources of energy. There is nothing clean about coal as a fuel. A master plan should be developed for infrastructure for the entire country, predicated on renewable energy. It is critical that all of the relevant ministries - environment, health, transportation, etc. - work together to generate the necessary data to improve both the environment and health in the years ahead. For human beings have the most impact on the environment, and without a clean environment, we cannot maximize our health and well-being.






Appendices

Appendix 1

Progress since 2014 and Future Challenges



Chapter 1

Ambient Air Quality

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Update target and environmental values	
Reduce ambient concentrations of PM ₁₀ and ozone in metropolitan areas in which concentrations exceed environmental values	
Develop a strategy for regular sampling of contaminants that cannot be monitored continuously	
Improve the spatial distribution of air monitoring stations	
Improve planning of sustainable transport	
Future Challenges	
Integrate epidemiological data from studies conducted in Israel in the assessment of the disease burden from air pollution and associated costs	
Collect data on the contribution of different sources to air pollution in Israel, using source apportionment techniques	
Full implementation of the National Plan to Prevent and Reduce Air Pollution	







Chapter 2

Indoor Air Quality (IAQ)





Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Conduct a pilot study on indoor air pollution in schools	
Conduct research on residential dust	
Future Challenges	
Establish a central national authority to address IAQ	
Conduct research on health impacts of IAQ, and on the relationship between ambient air pollution and IAQ *Expansion of the challenges presented in the 2014 report	
Formulate and publish recommendations for the public on ways to reduce exposure to indoor air contaminants	

Legend:  Significant Progress  Some Progress  Little or No Progress

Chapter 3 Environmental Tobacco Smoke

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Pass legislation banning smoking in schools	
Measure urinary cotinine levels in children	
Collect and publish national data on the prevalence of asthma in children and on asthma medication use	
Develop analytical techniques in Israel to measure cotinine levels in blood, urine and saliva	
Measure urinary cotinine levels in pregnant women	
Enforce legislation banning smoking in public places	

Chapter 4 Chemical Parameters in Drinking Water

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Conduct research on public health effects of consuming desalinated drinking water with low mineral content	
Develop requirements to limit the lead content of materials that come in contact with drinking water	
Establish a central database of emerging contaminants in drinking water	
Assess the impact of discontinuing fluoridation on children's dental health, especially among children from low socioeconomic strata	
Future Challenges	
Conduct an updated survey to examine lead levels in tap water in residences and institutions, including schools	
Develop a model to estimate mineral content (iodine and magnesium) at central mixing junctions and at points of consumption	

Legend:  Significant Progress  Some Progress  Little or No Progress

Chapter 5







Wastewater

New chapter, not included in *Environmental Health in Israel 2014*

Future challenges	
Challenge	
Conduct additional studies on potential exposure to pharmaceuticals and other contaminants via produce irrigated with wastewater	
Conduct risk assessment based on the presence of chemical contaminants in wastewater	
Create a database that integrates chemical and microbial monitoring in sewage, wastewater, in the field, and in agricultural produce	





Chapter 6

Pesticides




Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Formulate a list of prohibited and restricted inactive ingredients in pesticides	
Conduct biomonitoring of organophosphates	
Monitor pesticides in the air near schools and residences	
Improve enforcement of sales and use of agricultural pesticides	
Create an umbrella committee on pesticide registration / unify registration committees	
Establish a national database on pesticide poisoning in Israel	
Future Challenges	
Advance uniform and comprehensive legislation on registration and use of all types of pesticide	
Conduct risk assessment on pesticides based on children's diet	
Conduct periodic re-evaluation of all active ingredients approved for plant protection	

Legend:	 Significant Progress	 Some Progress	 Little or No Progress
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Chapter 7
Chemical Food Contaminants




Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Conduct a survey of aluminum in food, especially in baby food	
Conduct a survey of polycyclic aromatic hydrocarbons (PAHs) in food	
Evaluate the levels of heavy metals and radiation in crops grown in soil treated with coal ash	
Conduct a survey of phthalates in baby food	
Future Challenges	
Create a database of food consumption based on periodic National Health and Nutrition Surveys, and conduct more accurate exposure assessments for the general population and for sub-populations such as children and pregnant women	
Establish a TDS (Total Diet Study) project in Israel	

Chapter 8
Chemicals in Consumer Products



Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Require labeling of selected consumer products that meet the requirements of the standard	
Improve regulatory enforcement for consumer products (enforcement in markets and not only at import)	
Re-evaluate the role of the Ministry of Health in guaranteeing the adoption and implementation of standards that protect public health	
Future Challenges	
Advance comprehensive regulation of chemicals in consumer products	
Conduct additional surveys of chemicals in consumer products in the market in Israel; conduct a systemic review of requirements pertaining to chemicals in consumer products marketed abroad versus those in Israel	
Shorten the lengthy bureaucratic process of declaring standards as mandatory	

Legend:  Significant Progress  Some Progress  Little or No Progress

Chapter 9
Biomonitoring

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Join a regional or international human biomonitoring (HBM) project	
Develop laboratory capacity for HBM	
Develop a long term strategic plan for HBM	
Future Challenges	
Expand the process of selecting and prioritizing chemicals for HBM by including representatives from academia, government, and the public	
Establish and fund a government framework for HBM and/ or integrate HBM as a formal part of National Health and Nutrition Surveys	
Develop a framework for using HBM data in quantitative risk assessment	

Chapter 10
Non Ionizing Radiation (NIR)

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Re-evaluate standards in light of new findings regarding health effects of NIR exposure	
Monitor devices emitting NIR (such as transformers and power lines) in public spaces	
Future Challenges	
Establish mandatory regulations regarding permissible levels of NIR	
Increase public awareness regarding the potential adverse health effects of NIR, the need to reduce exposure, and the potential risks from exposure	
Evaluate the potential impact of Smart City technology and smart meters on the public's exposure to NIR	

Legend:	 Significant Progress	 Some Progress	 Little or No Progress
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Chapter 11
Climate Change

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Develop a national action plan to cope with climate change	■
Implement the National Plan to Combat Cutaneous Leishmaniasis	■
Create a national database that includes exposure metrics and health indicators related to climate change	■
Strengthen collaboration between the Israel Meteorological Service and the Ministry of Health in order to prepare for extreme climate events	■
Future Challenges	
Develop specific climate change indicators	

Chapter 12
Planning

New chapter, not included in *Environmental Health in Israel 2014*

Future challenges	
Challenge	
Conduct Health Impact Assessments on large-scale projects	
Expand the authority of Ministry of Health representatives in the planning committees in Israel	
Promote the planning and paving of bicycle paths <small>*related to challenges in Ambient Air Quality chapter</small>	
Improve the efficiency of public transportation <small>*related to challenges in Ambient Air Quality chapter</small>	
Promote shading in open public spaces	
Develop policies to reduce emissions of heat, radiation, and greenhouse gases	

Legend:	■ Significant Progress	■ Some Progress	■ Little or No Progress
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Chapter 13

Vulnerable Populations

New chapter, not included in *Environmental Health in Israel 2014*

Future challenges	
Challenge	
Identify vulnerable populations in Israel and adapt specific goals and objectives to the various vulnerable groups (in the context of the National Plan for Health and Environment)	
Conduct research on genetic variability and other vulnerability predictors to identify vulnerable populations	
Advance collaboration between government ministries and civil society organizations, to improve the flow of information regarding environmental hazards, and to promote mechanisms for public participation	

Chapter 14

Environmental Health Indicators and Trends

Progress on Challenges presented in <i>Environmental Health in Israel 2014</i>	
Challenge	Progress
Formulate environmental health indicators	■
Future Challenges	
Collect and publish data on various environmental health indicators	
Publish data collected by the authorities regarding environmental pollutants and health outcomes, making these accessible to researchers, policymakers and the general public in a timely fashion	

Legend:	■ Significant Progress	■ Some Progress	■ Little or No Progress
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Appendix 2

The Challenge of Funding Environmental Health Research in Israel

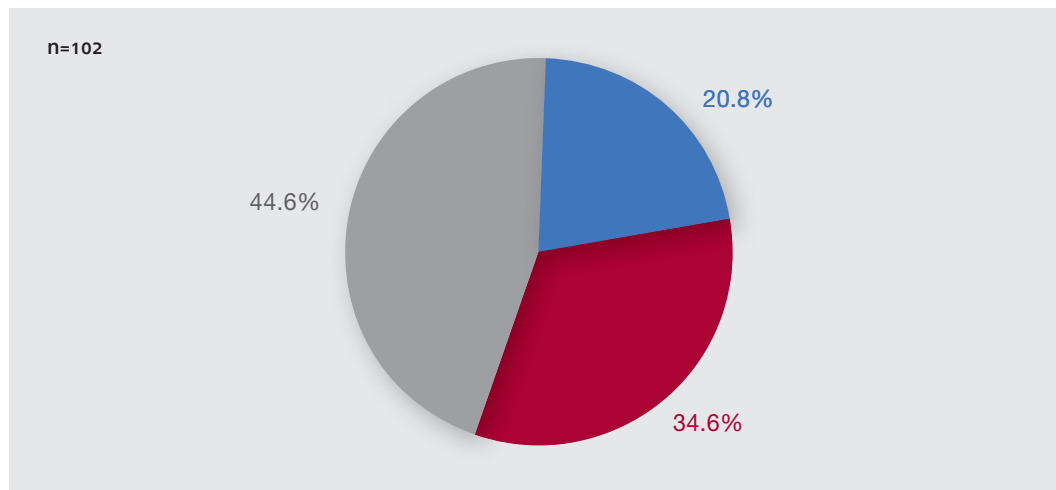
Each chapter in *Environmental Health in Israel 2017* includes a section on ongoing research and relevant research publications from the past three years. The report lists more than 100 different environmental health studies. Figure 1 displays the division of funding sources for these studies (excluding three studies with unknown funding source).

Funding sources are divided into three categories:

1. Government funded studies
2. Studies funded by the Environment and Health Fund
3. Other Funding Sources: Private funds, University funding, EU and United States funding programs and studies carried out without external funding

Expanding government support for environmental health research is an important challenge.

Funding Sources for Environmental Health Research Studies in Israel cited in this Report



← **Figure 1**
Source:
Environment and Health Fund

Legend: ■ Environment and Health Fund ■ Government ■ Other**

* The analysis does not include review studies and each research study is included once. Equal weight is given to each study. In the case of multiple funding sources for a given study, equal weight was allocated to each source.

** Other: Private funds, University funding, EU and United States funding programs and studies carried out without external funding.

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