Conference Proceedings

DO MICRONUTRIENT DEFICIENCY CONDITIONS EXIST IN ISRAEL IN 2019? Challenges and Opportunities for Food Fortification

Conference Date: Thursday, 7 November 2019
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Ben Zvi St, 12, Ashkelon, Israel

Sponsorship
Ashkelon Academic College
Department of Nutrition, Israel Ministry of Health
Israel Association of Public Health Physicians

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Summary

This document presents the proceedings of a national conference held at Ashkelon College on November 7th 2019 to report on the high prevalence of micronutrient deficiencies in Israel and to present a new policy commitment by the Israeli Ministry of Health (MOH) to require mandatory food fortification. The conference was co-sponsored and convened under the auspices of the Israel MOH Director of the Public Health Services, Ashkelon Academic College (AAC) School of Health Professions (including in Public Health and Nutrition bachelor's degree programs), and the Israeli Association of Public Health Physicians.

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Program	
9:00-9:30	**Welcome**: Prof. Shlomo Grossman – ACC President Prof. Siegal Sadetzki – Head Public Health Services, Israel Ministry of Health Prof. Hagai Levine – Chair, Israel Association of Public Health Physicians, Braun School of Public Health, The Hebrew University of Jerusalem
9:30-10:15	**Keynote 1:** ***Fortifying Food and Monitoring Nutrition Worldwide*** Prof. Omar Dary, USAID
10:15-10:35	***Keynote 2:Findings and Recommendations of the MOH Committee on Food Fortification*** Prof. Ronit Endevelt, Ministry of Health
10:35-10:55	***Are We Magnesium Deficient?*** Prof. Yonah Amitai, Bar Ilan University
10:55-11:10	***National Iodine Survey among Children and Women in Maccabi Health Services*** Dr Jonathan Arbelle, Maccabi Health Services
11:10-11:25	***Vitamin D Deficiency in Israel*** Prof. Ted Tulchinsky, Ashkelon Academic College
11:25-11:40	***Is There Still Folic Acid Deficiency in Israel?*** Dr. Matan Cohen, Hebrew University
11:40-11:25	**Coffee Break**
12:15-12:30	***Findings from the "MABAT" Israel Health and Nutrition Surveys*** Dr. Tali Sinai, Israel Center for Disease Control, MOH
12:30-12:45	***Regulatory Aspects of Food Fortification*** Ms. Anat Chavia Ben-Yosef, Food Service,MOH
12:45-13:00	***Fortifying the Food Chain with Nutrition Sensitive Agriculture*** Prof. Niva Shapira, Ashkelon Academic College, Nutrition Dept.
13:00-13:15	***Salt Iodization – An Industry Perspective*** Ms. Aliza Ravitzki – Melach Haaretz (Salt of the Earth) Ltd.
13:15-13:30	***Should We Spoon Feed Health - Mandatory Fortification or Free Choice?*** Prof. Boaz Lev, Emeritus Director General of the MOH
13:30-14:15	***Panel Discussion - all Speakers*** Chair, Prof. Aron Troen, The Hebrew University of Jerusalem, Institute of Biochemistry Food Science and Nutrition, School of Nutrition Science
14:15-14:30	***Conference Summary: A Road Map for Prevention of Nutritional Deficiencies and Fo Fortification for Israel*** Prof. Aron Troen, The Hebrew University of Jerusalem, Institute of Biochemistry Food Science and Nutrition, School of Nutrition Science
14:30	**Lunch**

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Opening Statement

Prof. Siegal Sadetzki; Director of Public Health Services, Israel Ministry of Health

Public health is fundamentally a multidisciplinary profession, and nutrition and food play a key role in promoting health and preventing morbidity. As everybody knows, the research and the food-labeling guidelines and recommendations, not to mention standardization on this subject, are very complex. Disagreements are not straightforward and there is no doubt of the influence of economic, cultural, and fashions. Through these tangled issues, we try to have a scientific and sustainable discourse.

Nutritional enrichment is considered to highly beneficial because it enhances the nutritional value of consumed food without the need to invest resources in changing the public's behavior to achieve fairly effective coverage of vulnerable target populations. This aspect of fortification is consistent with the approach to social responsibility and equality and resolves multiple failures we have seen in trying to impose responsibility and implement health promotion by changing solitary human behavior. Unfortunately, there are many failures in strategies that focus solely on individual responsibility.

Adopting food fortification as a public health policy has additional nutritional benefits: the cost of added nutrients is low in relation to the total cost of the enriched food (supplementation of micrograms of dietary ingredient per kg of food increases the price by only fractions of a percentage), so that in many cases the enrichment cost can be lowered for the consumer.

Quality control costs are often borne by the manufacturer. Global cumulative experience proves that mandatory enrichment programs are more effective than voluntary programs with a certain price control.

When there is experience with one nutrient component, for example, iron-enriched flour, it is easier and cheaper to add another nutrient to the same agent, for example adding folic acid to iron-enriched flour. It is widely accepted that standard-related enrichment costs, raising public awareness, as well as oversight and monitoring apply to governments. Therefore, the government must set a dedicated budget for this purpose.

The savings can be seen in improving the public's health and wellness, in reducing social gaps, and in reducing health care costs accordingly.

In Israel, the flour was enriched with Vitamin B until the 1970s but due to logistical problems and difficulties in quality control, and assuming that the dietary intake of the population was adequate, and therefore there were no more shortages so it was decided to stop mandated enrichment of flour.

Currently many foods in Israel are voluntarily enriched for marketing purposes to make the product look more attractive and healthy to the public. Thus snacks and cereals (ultra-processed foods) are enriched while basic products such as milk and flour are not.

Moreover, along with the increase in obesity rates, we are witnessing population nutritional deficiencies in what we call "hidden hunger". These conditions are especially prevalent in poorer people who consume excess calories from inexpensive energy-rich and nutrient poor foods, leading to both obesity and micronutrient deficiencies which result in a high burden of chronic disease.

In an attempt to settle this matter, the Ministry of Health set up a number of advisory committees, the most recent of which was established in 2015, with the appointment of the then-head of public health services, Prof. Itamar Grotto.

The head of the committee was Prof. Ronit Endevelt, who directs the Nutrition Department at the ministry, and it was attended by leading researchers and nutritionists in the various sub-committees. After more than two years of work, the committee submitted its recommendations, which we would like to present today, while discussing population deficiencies and trying to answer whether the enrichment mechanism is the most effective contemporary mechanism and under what conditions.

This conference will serve as a basis for the ongoing discussion in the Ministry of Health regarding the possibility of nutritional enrichment regulation, and this, of course, provided the discussion receives economic and legal prioritizing in the Ministry of Health.

Mandatory Food Fortification for Prevention of Nutritional Deficiencies: Health in All Policies Perspective

Prof. Hagai Levine; Chairperson, Israeli Association of Public Health Physicians, Israel Medical Association; Associate Professor, School of Public Health, Hadassah-Hebrew University

"Health in all policies" is an approach to public policies across sectors that systematically takes into account the health implications of decisions, seeks synergies, and avoids harmful health impacts in order to improve population health and health equity.

From a "health in all policies" perspective, ensuring healthy food and prevention of nutritional deficiencies at the population level, could be achieved by several combined strategies, such as: taxation of unhealthy food and subsidized healthy food, ban on advertisement and limiting marketing of unhealthy food, health education and mandatory food fortification. Prevention strategies should pay special attention to health disparities and disadvantaged populations.

In order to promote healthier food for improving public health we need a multi-dimensional partnership of professionals, researchers, civil servants, politicians, journalists and activists. This coalition should be strong enough to overcome the massive power of the food industry, who is affecting policy for their commercial interests, rather than for the public interest.

There are many considerations to take into account while making decisions regarding health-promoting policy, such as mandatory food fortification (Fig. 1, adapted).[1] We should first base our decisions on evidence: the epidemiology of nutritional deficiencies in our target populations and on evidence from interventions elsewhere. But we should not neglect other considerations: economic, legal, ethical, political, social, cultural, logistic and practical, organizational, history and tradition. Last but not least, leadership and timing may be crucial, and this may be the key element missing so far in Israel.

We look forward to learning from discussion of all aspects, with focus on the evidence, in this important conference, initiated by the Ashkelon Academic College, the Ministry of Health and the Israeli Association of Public Health Physicians.

Levine H, Krentzler Y, Davidovitch N. (2016). Health in All Policies – A Model for Health Promoting Policy. Chapter 14 in: Health Promotion: From Theory to Practice. ["In Hebrew"].

Introduction

Prof. Ted Tulchinsky; Ashkelon Academic College, School of Health Professions

Micronutrient deficiencies are recognized as a global public health problem. Deficiencies of key micronutrients at clinical and subclinical levels account for approximately 7.3% of the global burden of disease. Fortification of basic foods is an effective, safe and inexpensive strategy for preventing micronutrient deficiency. [1] Food fortification is one of the most successful public health intervention methods and is recommended by the World Health Organization[2]and UNICEF [3] as an effective strategy for addressing global public health, as common edible products are manufactured by well-developed industries and accessed by high percentages of consumers globally in high, medium and low income countries.

Food fortification has been used in North America since the early 20th century. This strategy has extended in recent years and widely adopted in Africa, the Middle East, and Asia, but less so in Europe. Throughout the years, fortification initiatives have shown their safety, efficacy and cost-effectiveness to reduce the damaging effects of micronutrient deficiency on human health.[4]

Switzerland in 1922 was the first country to implement an iodine fortification program and maintains it to the present time. The United States in 1924 adopted salt iodization as well to reduce the high prevalence of goiter [5]and iodine-dependent thyroid deficiency conditions. [6] The World Health Organization (WHO) and UNICEF strongly promote mandatory salt fortification with iodine and other strategies for addressing micronutrient deficiencies including food fortification. In the case of iodine deficiency, with an international consortium promotes this strategy has brought success in this global effort in most countries in the world, although continued monitoring and fortification adjustments may be needed.[7, 8]

In the USA, voluntary fortification of milk with vitamin D began in the 1930s and well accepted by producers and the public. Widespread awareness of rickets and the identification of Vitamin D brought voluntary fortification of milk with vitamin D to eliminate rickets, which was widespread in industrial cities of the US and Europe. [9, 10] Recently, rickets and vitamin D deficiency has become recognized as a global health problem for many vulnerable population groups. Recognition of milk fortification with vitamin D is as an effective means to prevent osteomalacia, osteoporosis, and fractures in the elderly with mandatory fortification of milk in some countries. [11, 12]

In the early decades of the 20th century, a major epidemic of pellagra resulted in some 100,000 deaths in southern states of the USA. Epidemiologic investigation proved this was not an infectious disease as widely believed in the medical community but was due to deficiency of vitamin B3 (thiamine). In the 1940s it became standard practice to fortify flour with iron and vitamin B complex (thiamine, riboflavin, and niacin).

Food fortification is considered by the CDC (Centers for Disease Control and Prevention) to be one of the ten greatest public health achievements of the US in the 20th century.[13, 14] Since 1998, wheat flour has been used as the primary vehicle of folic acid (vitamin B9) for preventing neural tube defects, as this abnormality appears within the first days of pregnancy when women might not be aware of the pregnancy.[15] Folic acid for the prevention of a group of birth defects collectively called NTD (Neural Tube Defects) was proven to be highly effective in 1991. As a result, the use of a daily folic acid supplement was recommended for all women of reproductive age, but compliance was generally low, with less than one-third of this population group. In order to overcome this barrier in preventing NTD

births, the United States authorized mandatory fortification of "enriched cereal grain products" with folic acid beginning in 1996. This policy was soon followed by mandatory folic acid fortification of all flour in Canada and Chile, leading to a documented reduction in NTD births in all three countries. Since then, 84 countries have implemented food fortification programs with folic acid.[16, 17, 18, 19]

Prof Dary our guest keynote speaker, is a noted international expert on micronutrient deficiency and food fortification has consulted on this topic in many countries. This includes Jordan and the Palestinian Authority (PA), both of which strengthened their salt iodization programs, and introduced mandatory fortification of wheat flour in consultation with Prof Dary and other world-class consultants in 2005-06. It is noteworthy that some of the fortified salt and flour used by the PA and Jordan are produced by Israeli manufacturers, demonstrating that Israel has the technological and industrial wherewithal to fortify these products for the local market should that be mandated.

The topic of micronutrient deficiency has been reviewed extensively over many years by the Ministry of Health. In 1996 the Ministry appointed the Berry Committee, which recommended adopting statutory food fortification and monitoring of the population's nutritional status. 15 years later, in 2011, the MOH published detailed recommendations for food fortification as part of the "Healthy Israel 2020" national government policy [20,21], which was adopted as part of a national government policy paper in 2011, but this was not promoted further. In 2015, the MOH convened a new food fortification committee headed by the Director of the Nutrition Department of the MOH, Prof. Ronit Endevelt. Although Israel does not conduct nationally representative human biomonitoring of nutritional biomarkers in the Israeli population, the committee compiled concerning evidence of multiple prevalent micronutrient deficiencies in the Israeli population. Nutrient intake data from national nutrition and health surveys (MABAT) of representative samples of children, adults and the elderly; from unpublished clinical chemistry findings using electronic medical records of HMO'S (health maintenance organizations); and from peer-reviewed academic studies; all provided compelling basis for the committee recommendations to implement a mandatory food fortification policy for Israel without delay. These data, together with the main committee recommendations, were presented publically at the conference for the first time, signalling the commitment of the Ministry of Health to follow through on the committee's findings.

The findings should not come as a surprise. Over the years, many reports have been published in the professional literature demonstrating substantial micronutrient deficiencies in Israel and recommending national needs to be addressed in keeping with international best practices of food fortification. [22, 23] In addition to long standing issues of iron deficiency and anemia in infants,[24, 25]vitamin D deficiency has been amply documented in Israel.[26,27,28,29] Recent unpublished data from the Ministry of Health hospitalization data set reports hospitalization of 124 cases of rickets between 2012 and 2017 with a total of 2072 days of hospital care (Haklai Z - personal communication, 2019). Barnea and colleagues reported a study of the Israeli national burden of hip fractures resulting from vitamin D and calcium deficiency osteoporosis costing nearly 720 million NIS in 2013.[30] Both rickets and the consequences of osteoporosis call for urgent measures to increase the vitamin D intake in all age groups by food fortification.

Although iodine deficiency was demonstrated in reports of goiter in Israel's northern region as far back as the 1950s, improvements in the nation's water supply were thought to have resolved the issue by the late 1980s. Since then, only one or two small studies measured urinary iodine, and even though they were not representative, they supported the erroneous belief that the Israeli population was iodine sufficient. Recently, however, in light of concerns that increasing use of mineral-poor, desalinated

seawater might deplete the population's intake of iodine, magnesium and other minerals, the first national survey of urinary iodine was carried out. This survey, in a nationally representative population sample of over 1000 pregnant women and 1000 school-age children, established that Israelis have inadequate iodine intake and are in the lowest decile of intake of all countries for which data are available [31, 32, 33, 34, 35]. This easily remedied situation is worrisome because iodine deficiency is the main cause of preventable mental retardation, as well as thyroid disorders even in adults.

The trend of increased desalination to meet the water needs of the population and agriculture thus bears with it health risks unless essential elements are replaced in the water supply or in other food vehicles. The case of desalination and the emergence of iodine and magnesium deficiency illustrate the critical need for routine periodic monitoring of the population's nutritional intake and status, so that appropriate corrective action can be taken. Other mineral inadequacies that need attention are iron, magnesium, calcium, zinc, and selenium.

The Ministry of Health conducted national surveys of nutrient intake in Israel for the years 2014-2016 of representative samples of the population that were presented at the conference. These "MABAT" surveys show an alarmingly high prevalence of deficiencies of important micronutrients that affect the Israeli population in all age groups surveyed. Self-reported estimated intakes of vitamins A, D, E, B6, folate, and calcium are particularly concerning, according to data presented at this conference by Prof. Ronit Endevelt and by Dr. Tali Sinai. Abstracts of these studies are included in these Proceedings.

Low fat milk (1%) and margarine have been fortified by law in Israel with vitamin A and D for many decades, however, the amount or the coverage appears to be insufficient to prevent deficiency of these vitamins in vulnerable groups. Infant supplements of vitamin A and D and iron have been routine for many years, but attention to other age groups is still necessary. Israel also fortified flour in the 1950s but this practice was stopped in 1989. The reasons for this policy change given were difficulty in monitoring and a feeling that there was no longer any need for fortification and that there were no prevalent deficiencies. Although there was no thorough assessment of the populations' nutritional status at that time. Indeed, population-wide nutrition surveys only began in Israel with the first MABAT survey of 1999-2001. The historic paucity of data and complete lack of routine nutritional intake studies and biomonitoring may help explain why Israel has been so slow to re-adopt food fortification, even with mounting evidence of serious micronutrient deficiencies.

Nevertheless, the Ministry of Health appointed three expert committees, in 1996, 2011 and 2015, all of which recommended mandatory fortification of salt with iodine, cows' milk with vitamin D, and flour with iron, folic acid, and other micronutrients, as well as labelling, enforcing and monitoring the fortification program according to the "the Canadian model".

Studies in numerous countries and settings [36] including the USA,[37] Finland [38] and low income countries such as the Cameroons in Africa [39] document the efficacy of fortification by raising biomarkers of essential minerals and vitamins. Even our neighbours in the Palestinian Authority and Jordan have successfully implemented food fortification as long ago as 2006, with Israeli food industries helping to supply them with fortified flour and salt.[40, 41.] Surely, Israel should be capable of doing the same to mitigate manifest micronutrient deficiencies in its population?

Our keynote guest speaker Prof. Dary presented an international overview of food fortification[42]. Israeli presenters covered many topics on providing evidence from national surveys of highly prevalent deficiencies in folic acid, vitamins A, B group, D, iodine, iron, magnesium and others - all vital for human health throughout the lifespan.

The societal and ethical argument for food fortification is another crucial consideration in favour of mandatory fortification. Israel has some 2.3 million people (530 thousand families) living in poverty out of some 9 million total population, including 842,300 (31.2%) children. [43, 44] . Voluntary, market-driven fortification will not solve their problem. Manufacturers charge a premium for voluntarily fortified foods, which typically target high income and highly educated sectors of the population. Israel's poverty rates and socioeconomic divides are among the largest in OECD countries, driving food insecurity among vulnerable groups from all sectors of the population. Higher prices, limited coverage and lack of awareness all combine to render market-driven voluntary fortification a less effective policy alternative than mandatory fortification. This is a public health issue of utmost importance.

Updated sources from the US National Academy of Science, the international reference standards, are listed below. [45]

The Conference summary panel strongly endorses mandatory food fortification as recommended by the Endevelt Committee and calls for its urgent and complete implementation. This conference will hopefully mark a major step forward in nutritional security policies for Israel and with implementation to reduce the manifest nutritional deficiencies and health inequalities in the Israeli population.

Keynote 1: Fortifying Food and Monitoring Nutrition Worldwide

Dr. Omar Dary; USAID

Micronutrient deficiencies are recognized as a globe public health concern, affecting an estimated 2 billion people worldwide (Silvia Maggini, 2018, Regan L. Bailey, 2015). Micronutrients are essential for human health. (Regan L. Bailey, 2015). Micronutrient sufficiency status can be characterized along a continuum, with several key marginal points; Estimated Average Requirement, **EAR;** Tolerable Upper Intake Level, **UL;** maximum requirement (two standard deviations higher than the EAR values) and Nutrition Recommended Nutrient Intake, **RNI**).

Determination of nutrient requirements at the individual level is complex, therefore, recommendations for individual purpose are based on RNI values; whereas, populational recommendations aim towards the intake of quantities between the EAR and the UL values. When large proportions of the population are unable to reach the EAR values, a practice for complementing the nutritional value of the diet has been providing micronutrients beyond those present in the natural foods, such as supplementation and food fortification. These practices have been used in public health since the beginning of the 20th Century.

The individual biological impact of any micronutrient intervention depends on the need of that nutrient and on the quality and amount of the supplied micronutrients rather than to the vehicle, although the nature of the latter determines the population coverage and the sustainability and permanence of the intervention. Food fortification, when implemented using commonly and widely consumed food vehicles that are manufactured by formal and a few food industries, has shown to be the most effective and low-cost intervention, as it takes advantage of already existent delivery mechanisms. (Monitoring and Evaluating Food Fortification Programs: General Overview Technical Consultation July 7, 2006) Thus, for example, only $0.02/year per person are needed for providing sufficient iodine through iodized salt, and from $0.25-$0.50/year per person for complementing together most of the other micronutrients in the diets, using food vehicles such as cereal flours, dairy products, vegetable oils and sugar. The accuracy of a suitable food vehicle depends on population dietary habits and the food industry structure.

Several successful cases of food fortification have been documented: neural tube defects associated with folate deficiency are being prevented by the addition of folic acid to wheat flour in Canada, the United States, Australia, South Africa, Chile, Costa Rica, and the Middle East; incorporation of iron to both wheat flour (Makhumula et al. Manual for internal monitoring of fortified wheat flour, 2007) and milk has improved the iron status and reduced anemia in Costa Rican children; vitamin A supplied through sugar has maintained vitamin A sufficiency in Guatemala and other countries of Central America; iodine provided through salt maintains iodine sufficiency worldwide. Similar achievements have not been demonstrated for reduction of rickets due to vitamin D deficiency, as well as nutritional status of vitamin B_{12} and zinc, because the provided amounts have been insufficient or, most probable, because the impact has not been well measured.

Implementation of effective food fortification programs requires not only the enactment of standards and regulations but also the introduction of reliable mechanisms of compliance and enforcement, as well as surveillance and evaluation of the performance and benefits of these programs at the population level. In the absence of these elements, permanent appreciation and attention for the food fortification programs cannot be created and maintained. These activities can be implemented at low cost, but it requires of novel, simple, and common-sense methodologies. Thus far, too complicated and costly procedures are limiting the introduction, expansion and monitoring of these programs. In conclusion, there is a clear need for collaboration of professionals from different disciplines to promote an efficient food enrichment program

Keynote 2: Findings and Recommendations of the MOH Committee on Food Fortification in Israel (2015-2019): From Research to Policy

Prof. Ronit Endevelt; Director of the Nutrition Department of the Israel Ministry of Health

Background

Food fortification is considered a cheap and cost-effective method to balance the nutritional needs of populations while increasing equality. Previous MOH-appointed committees recommended food fortification: In 1996 the Berry Committee recommended mandatory iodine fortification of salt, Flour fortification with iron, calcium and B- vitamins; and fortification of milk with vitamin D. The "National Nutrition Committee 2020" published its recommendations in 2011 once again advocating in favor of food fortification, with similar recommendations to the Berry Committee.

The Current Fortification Committee

In 2015, the current Micronutrient Fortification committee focused on a framework for policymaking and implementation. Fundamental elements included review of existing data on nutritional status in Israel, investigation of fortification and food regulatory status, quantifying the prevalence of current morbidity, examining public and professional knowledge on the topic, and the development of recommendations, guidelines, and regulatory tools. Four professional committees were created:

1. Food chain from the agriculture crops to the plate
2. The regulation committee
3. The bio-monitoring committee
4. The surveillance committee

Findings - Why it is important to fortify?

1. Nutritional fortification enhances the nutritional values of the food consumed without the need to invest resources in the behavioral change of the public and within effective coverage of vulnerable target populations.
2. The cost of micronutrients is minimal in relation to the total cost of the fortified food; in many cases the enrichment costs can be reduced to the consumer.
3. Quality control costs are often borne by the manufacturer.
4. Cumulative evidence across multiple countries suggests that mandatory enrichment programs with some price controls are more effective than voluntary programs.
5. It is easier and cheaper to add additional nutrients to an existing carrier (e.g., adding folic acid to flour already fortified with iron). Fortification costs related to regulation, labeling, communication and public awareness, and government control and monitoring are minimized when fortifying a single vector with multiple micronutrients.
6. Benefits include overall improvement in the health and quality of life for the population, in reducing social gaps, and in reducing health care costs accordingly.

Type of fortifications:

1. Mandatory (i.e., through legislation)
2. Voluntary, although sometimes enshrined in legislation regarding the amount allowed to be added, and sometimes not

Challenges in developing a national fortification policy:

1. Lack of a proper national nutrition status monitoring system that includes biochemical data (biomarkers).
2. Unknown scope of voluntary fortification of food in Israel
3. Unknown current contribution of the total intake of nutrients in the population
4. Uncertainty about how many foods are fortified without any control?
5. Excess consumption, especially for nutritional components where the gap between recommended intake and UL is low.
6. Unnecessary fortifications of many foods; Manufacturers use fortification as a tool for healthcare and commercial marketing of harmful foods such as soft drinks, snacks, and sweets to be perceived by the consumer as "healthier".

Food Chain Committee recommendations:

1. Finding solutions for climate change impact on Mediterranean crops.
2. Promoting nutritional/ health value of basic foods and strengthening the nutritional aspect - functional of plant and animal food.
3. Improving the quality of the animal- and plant-food chain.
4. Study the control of desalinated and recycled water and the effects on food quality.
5. Promoting agricultural waste management and waste utilization.
6. Emphasizing the nutritional aspect of agricultural quality indices relating to the food chain, to promote health-oriented agriculture to both man and the environment.
7. Developing a network of researchers raising levels of nutritional components - vitamins and minerals, natural substances, and phytonutrients to improve the food chain
8. Establishing a comprehensive laboratory to create a validated and updated food composition database of all food components currently being consumed in Israel.

Resources and actions are needed to improve nutritional deficiency states:

1. Establishment of a monitoring and control management system
2. Legislation on mandatory fortification:1) Salt iodization, 2) Milk enrichment with Vitamin D; 3) Iron, B-Vitamins, Folate and B12 in flour
3. Details of the standard fortification specification for each dietary supplement and the appropriate vector
4. Create partnerships with all stakeholders - population, science, research, industry, law
5. Social market for public partnership

Personnel resources and budget to implement fortification policies

1. MOH Nutrition Division: A unit that includes nutritionists looking to improve the databases and regular monitoring, including updated fortification mandatory and voluntary mandates, with regular academic and international consultations.
2. MOH Food Services: Enrichment quality control and internal-industrial quality control: laboratories must be recognized by the Ministry of Health on a frequent basis in accordance with existing international rules.
3. External quality control: quality control of state monitoring and laboratory samples.
4. Composing the regulations and passing it in the Knesset

Recommendations for Legislation

Fortification vector	Nutrients
Milk and milk substitutes	Vitamin D 400 Microgram
Table salt	Iodine 30 ppm
Flour including gluten-free	B Vitamins, Folic acid, Vitamin B_{12}, Iron

Developing a suitable national fortification policy will improve the wellbeing of the Israeli public, reduce health and social disparities, prevent enormous waste of unrealized human potential and significantly reduce health system costs to the Israeli economy.

Conclusion

The committee recommends the urgent enactment of a sustainable, statutory fortification policy based on reliable and up-to-date data as part of an overall nutrition and health strategy for Israel, in keeping with international and WHO best practice guidelines.

Micronutrient Deficiency Conditions in Israel: Abstracts

Do Nutrient Deficiencies Exist in Israel 2019? Gathering the Evidence

The conference presented compelling evidence on the concerning state of micronutrient deficiencies in the Israeli population:

Prof. Yona Amitai, presented evidence of magnesium deficiency and its attendant cardiovascular risks. This problem is apparently aggravated by increasing reliance on seawater desalination; a process presenting an important step towards water supply sustainability for Israel, but carrying significant public health consequences that should be carefully considered.

Dr. Jonathan Arbelle presented findings from a national survey of iodine status conducted by Ovadia and colleagues among school age children and pregnant women from among Maccabi Health Services. The study, which was published in Thyroid in 2017, showed that iodine intake of the Israeli population is deficient, falling in the lowest decile of iodine intake worldwide. Iodine deficiency is hypothesized to be aggravated by increasing use of desalinated seawater for community water supply.

Inadequate Vitamin D intake was found in Ministry of Health MABAT studies in all age groups. Blood measures from electronic medical records of the Israeli sick funds also showed highly prevalent deficiency rates (data not presented). Hospitalization data of the Ministry of Health showed unexpectedly high rates of rickets in Israeli children up to adolescence were reported by Prof. Ted Tulchinsky, as additional evidence representing the tip of an iceberg of vitamin D deficiency.

Dr. Matan J Cohen presented a study by Dr. Annie Reiss and colleagues, that assessed the rates of Neural Tube Defects (NTDs) in national birth registry data over a twelve-year period in Israel following the Ministry of Health recommendation for Folic Acid supplementation by women of reproductive age. They found a nearly twofold reduction in NTD rates following the new guidelines in the absence of fortification. Nonetheless, Israeli NTD rates remain significantly higher than in other developed countries that have fortified flour with Folic Acid, and they called for fortification to eliminate the remaining preventable birth defects.

Finally, self-reported estimated dietary micronutrient intakes from the Israeli National Health and Nutrition Surveys, (MABAT) 2014-2016 were presented by Dr. Tali Sinai, showing the majority of the Israeli population to be at risk for micronutrient deficiency, especially vitamins A, C, D and E, folate, calcium, magnesium and iron.

The gathered evidence, while compelling, highlights the need for routine, systematic, and comprehensive, nationally-representative human biomonitoring of nutritional indicators. Ad-hoc studies cannot be relied upon to provide timely actionable evidence of emerging nutritional deficiencies and related health conditions.

Are We Magnesium Deficient? Magnesium Deficiency Aggravated by Seawater Desalination and Adverse Health Effects

Prof. Yona Amitai, Meital Shlezinger, Michael Shechter; Bar llan University

Israel produces 600 million cubic meters of desalinated seawater (DSW) per year, which constitutes 60% of the drinking water (DW) supply. While using DSW is vital, it may cause adverse health effects, because magnesium, fluoride, and iodine, essential for human health are removed during desalination. The Ministry of Health (MoH) estimated ten years ago, that lack of magnesium in DSW could cause 250 fatalities annually. As DSW supply has doubled since then, the number of life lost is probably twice.

Only 20% of a person's daily magnesium supply comes from water, and 80% from food. Magnesium derived from water is a "safety net" for the majority of the Israeli population whose dietary magnesium intake is below the recommended WHO levels. Consumption of magnesium deficient water may aggravate magnesium deficiency.

Numerous papers have shown that magnesium deficiency can cause increase cardiovascular morbidity and mortality, diabetes and colon cancer. Studies have shown higher cardiovascular morbidity and mortality in association with consumption of DW with low magnesium content.

We have conducted the first study of evaluating the risk of cardiovascular mortality in association with consumption of DSW. We evaluated 30-day and 1-year all-cause mortality of acute myocardial infarction (AMI) patients enrolled in the biannual Acute Coronary Syndrome Israeli Survey (ACSIS) during 2002-2013. Patients (n=4678) were divided into 2 groups: those living in regions supplied by DSW (n=1600, 34.2%) and non-DSW (n=3078, 65.8%). Data were compared between an early period [2002-2006 surveys (n=2531) - before desalination] and a late period [2008-2013 surveys (n=2147) - during desalination].

The thirty-day all-cause-mortality was significantly higher in the late period in patients from the DSW regions compared with those from the non-DSW regions (HR=2.35 CI 95% 1.33-4.15, P<0.001) while in the early period there was no significant difference (HR=1.37 CI 95% 0.9-2, P=0.14). Likewise, there was a significantly higher 1-year all-cause mortality in the late period in patients from DSW regions compared with those from the non-DSW regions (HR=1.87 CI 95% 1.32-2.63, P<0.0001), while in the early period there was no significant difference (HR=1.17 CI 95% 0.9-1.5, P=0.22). Admission serum magnesium level (M±SD) in the DSW regions (n=130) was 1.94±0.24mg/dL compared with 2.08±0.27mg/dL in 81 patients in the non-DSW (P<0.0001). Thus, higher 30-day and 1-year all-cause mortality in AMI patients, found in the DSW regions may be attributed to reduced magnesium intake secondary to DSW consumption (1).

A subsequent historical prospective analysis was done in 177,900 members aged 25-76 during 2004-2013 of Clalit Health Services, using its electronic medical record database. Multivariable analyses were adjusted for age, sex, socioeconomic status, smoking status, and body mass index, comparing population living in regions where DSW provided the main DW supply compared with those living in regions with no DSW. An increased odds ratio was found for Ischemic Heart Disease (IHD) (0.96, 95% CI 0.93-0.99 at baseline and 1.06, 95% CI 1.02-1.11 at the end of the follow-up period), in those living in the DSW

regions, but no time trend was observed. While the risk for IHD increased during the study period, the risks for diabetes and colorectal cancer (CRC) were unchanged. Long-term studies are needed for assessing the risk for CRC due to the long latency. The higher risk for IHD has practical public health implications and raise the need to add magnesium to DSW.

Scientists from Gilat Research Center examined the effects of irrigation with DSW on agriculture. They found a gradual decrease of magnesium and sodium concentrations in produce grown in Israel since the inception of nationwide seawater desalination in 2008. Also in 550 samples of 29 different fruits and vegetables, magnesium levels were considerably lower than in those taken from the USDA database.

In conclusion: The use of DSW in Israel is associated with increase in cardiovascular morbidity and mortality and marked reduction of magnesium in DW and in fruits and vegetables. We call the Israeli MoH to enhance the plan for adding magnesium to DSW, with no further delay.

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Iodine Deficiency in a National Iodine Survey among Children and Women in Maccabi Health Services

Dr. Jonathan Arbelle; Maccabi Health Services

Data regarding iodine sufficiency amongst populations have been collected and presented for many years on the Iodine Global Network's (IGN) website. Many countries around the world have set up programs to increase population consumption of iodine and thus reduce worldwide iodine insufficiency disorders.

Data regarding iodine sufficiency in Israel was lacking until 2017, when the first national Israeli iodine sufficiency survey was completed and published (Ovadia Y, Arbelle JE, Gefel D et al. Thyroid 2017:27). Urine samples were collected and tested in the Maccabi Health Service (MHS) central laboratory. Our data showed mild to moderate iodine insufficiency among school age children and iodine deficiency among pregnant women. All areas of the country were similarly affected. Both groups had amongst the lowest levels of urinary iodine concentrations of all countries listed in the "global iodine scorecard" published on the IGN website.

The importance of our publication was not only in the presentation of novel data on iodine insufficiency in Israel. No less important was the novel method used for screening the population. The Ministry of Health's Helsinki Committee approval board accepted the concept that in this case the public good overrode the traditional framing of individual autonomy. They accepted a bioethicists argument that the concept of autonomy includes protection of the individual's right to health, and given that iodine determination in spot urine samples do not yield clinically actionable information, allowed for testing of de-identified urine samples after clinical tests had been completed and before they were discarded. The possibility to collect and test multiple samples a data set from all sections and sectors of the country allowed the quick and inexpensive survey of iodine sufficiency in the country. Additionally as electronic clinical records have been used for decades in MHS, big data is available to proceed with studies which will enable follow-up of future iodine supplementation programs in Israel

In view of the low iodine sufficiency affecting all sectors and all parts of the Israeli population, a call is made for the urgent implementation of a national iodine fortification program. Using methods such as we have developed for iodine sufficiency screening and using big data routinely collected in electronic medical records, such a program could be easily monitored.

Source: Ovadia YS, Arbelle JE, Gefel D, Brik H, Wolf T, Nadler V, Hunziker S, Zimmermann MB, Troen AM. First Israeli National Iodine Survey Demonstrates Iodine Deficiency Among School-Aged Children and Pregnant Women. Thyroid. 2017.27(8):1083-1091. doi: 10.1089/thy.2017.0251

Vitamin D Deficiency in Israel

Prof. Ted Tulchinsky; Ashkelon Academic College

Vitamin D deficiency is a long-standing health concern and currently considered a worldwide pandemic requiring a high priority public health response. Vitamin D is a fat-soluble vitamin normally produced by sunlight acting on the exposed skin. It is essential for bone health, for preventing rickets, osteoporosis resulting in hip and other fractures, and for preventing carcinogenesis, cardiovascular diseases, and other diseases associated with aging.

The commonest clinical manifestation of vitamin D deficiency is rickets, yet even milder deficiency damages foetal development. Development of nutritional sciences in the 1920s revealed the cause of rickets to be lack of sun exposure in blighted urban slums, and a successful method to ensure adequate vitamin D intake in the public by recommending cod liver oil in the diet for children. Vitamin D fortification of milk began in North America in the 1930s and grew rapidly in the 1940s. As seen in Canada, premature cancellation of wartime milk fortification led to a comeback of rickets, which is now reappearing around the globe, including in high-income countries.

Adequate vitamin D fortification and supplementation to prevent rickets during pregnancy and childhood are vital public health policy issues globally. In 2003, the American Academy of Pediatrics (AAP) recommended vitamin D supplementation for all infants, especially those being breast fed, and for children; in 2008, the AAP recommended an increase in the daily intake for all children up to age 18 to 400 IU per day. Well-baby clinics in Israel have for many decades recommended supplements with vitamin D drops for all infants from birth to one year of age; however, the rate of compliance has not been studied.

Recent studies of nutritional intake of children, adults and elderly (MABAT studies between 2014 and 2016 show high percentages of low and deficient intakes in all three age groups (see abstract by Dr. Tali Sinai and colleagues). Data from electronic medical records, obtained from three of the four Israeli Sick Funds and representing some 40% of the Israeli population were reported at this conference by Prof. Ronit Endevelt. The unpublished data found that over 80% of tens of thousands of clinical chemistry tests of members of the sick funds who were referred to vitamin D testing, reveal low vitamin D status or frank deficiency in all age groups. High rates of vitamin D deficiency in the total child and adult population are the tip of an iceberg for developmental damage to infants lasting into school age, and of osteoporosis and fractures among adults and the elderly placing a heavy burden of disease and economic costs to the health system and society. These indications of prevalent vitamin D deficiency are consistent with hospital discharge data in Israel between 2012 and 2017 showing unexpectedly high rates of rickets especially between infancy and 14 years of age.

Israel has mandated vitamin A and D fortification of margarine and in 1% milk for many decades. The Israel Standards Institute is now in the process of mandating fortification of all cow’s milk. Fortification in flour as in the Palestinian Authority may also be necessary.

Unpublished data from the Ministry of Health on hospitalization for rickets shows an average of 17.7 admissions utilizing an average of 296 days of care in the same time period 2012to 2017. A 2018

publication by Berner et al reported a study of hip fracture incidence and costs of care by Sinai and colleagues showed costs of over 270 million shekels in treatment with high rates of death in the first and subsequent years following the hip fractures mostly due to long term vitamin D and calcium deficiencies.

Vitamin D deficiency in Israel, as in many countries, is a preventable condition that results in important morbidity in all age, gender and ethnic groups.

Mandatory milk fortification of all milk and a monitoring program should be urgently implemented in Israel as recommended by three major special committees of the Ministry of Health and by former and current director generals of the Ministry. The Milk Committee of the Israeli Standards Institute which is responsible for milk regulations approved mandatory fortification of milk in the past year which should take effect in approximately 2 years. It is incumbent on the Ministry to supervise the compliance of manufacturers in the process, production and follow-up on Vitamin D in the population, as well as a program to promote public awareness and knowledge of vitamin D in milk and supplements for special groups such as pregnant women, infant and children as well as older population groups. Caregivers should promote suitable vitamin D supplements during pregnancy, lactation as well as for infancy, child, adult and senior groups.

Rate of Vitamin D Insufficiency in Blood Tests of Sick Fund Members, Israel 2016*

Age	% Borderline or Deficient
0-12 months	28%
1-3 years	53
4-10	76
11-18	85
19-50	84
51-64	85
65+	79
All ages	**83**

Source: Personal communication, Endevelt R, Director Department of Nutrition, Israel Ministry of Health.

Data are derived from three of four Sick Fund electronic medical record databases.

Notes: % rounded to nearest number. *International Norms: Borderline 10-32 ng/ml; deficient <10 ng/ml

Hospitalizations and Length of Stay for Rickets in Israel, 2012-14 and 2015-17						
Age/Discharges/ Total Days	Discharges		Bed days		Mean Length of Stay	
Age	2012-14	2015-17	2012-14	2015-17	2012-14	2015-17
00_	9	10	508	640	56.4	64.0
01_04	13	8	92	156	7.1	19.5
05_14	21	20	88	92	4.2	4.6
15_34	8	12	33	58	4.1	4.8
35_54	8	5	86	137	10.8	27.4
55_64	0	3	0	10	0	3.3
65+	4	9	73	99	18.3	11.0
All	60	64	880	1,192	14.7	18.6

Note: Includes ICD9 826.0 and 826.1 i.e., acute and chronic rickets, 2012-2017
Source: Haklai Z. Hospital Discharge Information System, Israel Ministry of Health, 2019

Is There Still Folic Acid Deficiency in Israel? Israeli national neural tube defects following Folic acid supplementation policy

Dr. Annie Reiss, Dr. Matan J Cohen; The Hebrew University of Jerusalem

Neural tube defects (NTD) are common and disabling congenital malformations. Despite prevention efforts, these defects remain a public health challenge both globally and in Israel. In 2000, the Ministry of Health published recommendations on daily folic acid (FA) supplementation for women of reproductive age. We evaluated the long-term impact of the policy recommending folic acid supplementation on NTD rates in Israel and the need for further changes in policy.

We found a substantial, nearly twofold reduction in NTD rates over a twelve-year period following the FA recommendations, from 17.9 to 9.7 cases per 10,000 live births. Rate reductions were seen in all ethnic groups, although rates in the Bedouin population remain high. Nonetheless, Israeli NTD rates remain higher than in other developed countries. Most NTD affected pregnancies were terminated. This was true in all subgroup analysis except for women with primary school education alone. These were the same group with overall higher NTD rates.

There is a need for further vigorous implementation of FA interventions in Israel, especially in vulnerable population. The global success of mandatory fortification of grain strongly advocates its consideration in Israel.

Micronutrients in the Israeli Diet: Results from the Israeli National Health and Nutrition Surveys, 2014-2016

Dr. Tali Sinai, Lubel S, Axelrod R, Shimony T, Nitsan L, Goldsmith R, Keinan-Boker L; Israel Center for Disease Control, MOH

Background: Low intake of several micronutrients, in particular vitamin D, iodine, calcium and magnesium, were reported to be of public health concern. Iron and folate consumption may also be lacking in certain groups, e.g., young children, women of childbearing age and during pregnancy.

Objective: The aim of this study was to estimate the prevalence of inadequate consumption of 16 micronutrients in the Israeli diet by various age groups.

Methods: We used the 2014-2016 Israeli National Health and Nutrition Surveys (RAV-MABAT) data. The representative cross-sectional surveys included: MABAT KIDS (2-11 years old, n=1792), MABAT ADULTS (18-64 years old, n=2957) and MABAT ZAHAV (≥65 year old, n=1039). Nutritional intake assessment was based on the 24-hour dietary recall method, conducted in a face-to-face interview, at the interviewee's home. Micronutrient consumption were estimated using the Israel Food and Nutrient Database, and were compared to the Dietary Reference Intakes (DRI). Results are presented as % below the Estimated Average Requirement (EAR).

Results: There was complete information on food intake for 1768 children (98.7%), 2904 adults (98.2%) and 937 (90.2%) elderly. Prevalence of nutrient intake below the EAR by survey is presented in Table 1. Over 40% of the adults and the elderly intakes were below the EAR for 10 of the 16 nutrients. Results varied from 3.6% for copper to 95.9% for vitamin D (ages ≥2 y).Noticeable deficiencies were observed in the intake of vitamin D and calcium with over 90% and over 75% of the population, respectively.

For the 9-11-year-old subgroup, the percentages of nutrient intakes below the EAR (i.e. vitamin A - 77.1 %, folate - 56.8%, magnesium - 45.7%) were similar to those of the older age groups and about 1.5-3.5 fold higher compared to those aged 2-3 y and 4-9 y. Insufficient consumption of phosphorus was markedly high (81.6 %) in the 9-11-year-olds.The prevalence of low iron and folic acid intakes was higher in females than in males, mainly in children (4-11 y) and woman of childbearing age (18-44 y).

Analysis by ethnic group showed similar results among Arabs and Jews, with slightly higher percentages of intakes below EAR of vitamin A, vitamin D, Riboflavin and iron, and lower percentages for calcium and zinc, among Arabs compared to Jews, in most age groups. No data were available regarding iodine intake, as food content of iodine is lacking in the Israeli database.

Conclusions: The majority of the population in Israel is at risk for micronutrient deficiency, especially for vitamins A, C, D and E, folate, calcium, magnesium and iron. Efforts to increase essential nutrient consumption are needed, especially among high-risk populations such as children, pregnant women and the elderly. Systematic and routine periodic monitoring of micronutrient consumption as well as biomonitoring is warranted. It will also be important to update and complete missing micronutrient data in the Israel Food and Nutrient Database for future analyses and surveys.

Table 1: Prevalence of intakes below the EAR of micronutrient in the Israeli diet

Nutrient	**MABAT KIDS** **2-11 y** **N=1768**	**MABAT ADULTS** **18-64 y** **N=2904**	**MABAT ZAHAV** **≥65 y** **N=937**
Vitamin A	55.3	75.3	71.4
Vitamin C	30.2	58.3	54.3
Vitamin D	95.9	92.3	92.8
Vitamin E	64.2	87.4	90.6
Thiamin (Vitamin B_1)	17.5	47.0	56.9
Riboflavin (Vitamin B_2)	11.1	30.2	27.0
Niacin (Vitamin B_3)	18.0	23.0	26.9
Folate (Vitamin B_9)	33.2	72.5	77.0
Vitamin B6	11.2	35.0	56.9
Vitamin B12	17.2	45.6	49.5
Calcium	77.6	80.7	88.6
Iron	9.1	29.3	23.7
Zinc	23.8	57.3	67.8
Magnesium	14.7	54.8	59.4
Phosphorus	25.6	18.8	20.6
Copper	3.6	20.5	24.3

Percentages are presented with sample weights applied.

Note: The Estimated Average Requirement (EAR) is the intake level for a nutrient at which the needs of 50 percent of the population will be met. The EAR is not useful as an estimate of nutrient adequacy in individuals, because it is a mean requirement for a group, and the variation around this number is considerable. At the EAR, 50% of the individuals in a group are below their requirement, and 50% are above it. Thus, a person whose usual intake is at the EAR has a 50% risk of an inadequate intake during the reporting period. An individual with an intake between the RDA and the EAR would have a risk of inadequacy between 50 and 2–3%. An individual with a usual intake below the EAR would have a risk of inadequacy between 50 and 100%. This is because the EAR is derived from a group estimate.

For details of the MABAT design, operation and findings in Hebrew, partially in English:

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Fortifying the Food Chain with Nutrition Sensitive Agriculture

Niva Shapira; Department of Nutrition, Ashkelon Academic College

Despite the age of abundance and the increase in availability and accessibility of food components, suboptimal nutrition and hidden hunger is still highly prevalent even in high income countries. This is due to factors including loss of vitamins and minerals over the course of industrial processing, nutritional poverty in weak populations, and/or primary and secondary deficiencies in soil and water due to geographical, climate, and agricultural factors like exhaustion of land and sea resources, overuse of fertilizers and pesticides, and more.

“Health Oriented Agriculture” aims to redirect food composition toward positive effects on human and environmental health, beyond the price-driven agriculture that may harm sustainability of the food chain.

Food enrichment/fortification with specific nutrients is the accepted nutritional/medical way of protecting public health against specific deficiencies proven to be a common risk factors in a population. However, because food components – nutrients and phytonutrients – work together, and all are required for optimal body health and function, awareness is growing of the potential advantage of the agricultural bio-fortification (BF) approach for enhancing the complete nutritional value of the food chain.

Carrier foods would be those widely and frequently consumed in regular diets, have tendency to concentrate the insufficient/deficient/missing components, and demonstrating synergism with the supplemented nutrients – supporting their assimilation and contribution to health, e.g., iron in beans, iodine and selenium in carrots, and many essential nutrients in milk and eggs.

BF in plants can be achieved through a variety of technological, agricultural, and genetic methods – conventional hybridization and/or genetic modifications/manipulations –with proven cost-benefit advantage and very high utility.Soil fertilization and/or foliar spray have been shown to increase zinc and iron in grains and beans, and nitrate fertilizers potentially enhance their absorption and concentration in the edible parts. In repeated field studies, foliar spray of mixed nutrients increased grain zinc by 65%, iron 12%, and selenium and iodine approximately 300% and 900%, respectively. Selenium and iodine concentrations demonstrated effective augmentation in vegetables like carrots, lettuce and cauliflower. Beta carotene has been significantly genetically enhanced in sweet potato, rice and maize, to attain pro/-vitamin A Dietary Reference Intakes (DRI) through regular diets.

Animal foods would be advantageously selected as nutritional enhancers for their inherent nutritional value, including high-quality proteins and concentrated vitamins and minerals. Primary foods – milk and eggs, which have complete composition and unique capacity to concentrate essential nutrients for development and function – are leading carriers, especially eggs, which can effectively concentrate many micronutrients, including vitamins A, D, and E, and essential minerals selenium and iodine, and effectively enhance effectiveness of omega-3 polyunsaturated fatty acids. All the above can be attained by low marginal added costs, and thus widely affordable. This is especially important for malnourished populations, where animal-based BF can be considered as nutritional enhancement even in small amounts.

Israeli studies on food fortification with vegetarian (Flaxeed/Linseed) Omega-3 ALA showed significant increase in chicken eggs, meat, fish, and milk of omega-3 Polyunsaturated fatty acids **(**PUFA) and n6:n-3 ratio - about 3-5 times; and eggs with alpha Linolenic acid (ALA) further showed significant elongation of ALA-to- Docosahexaenoic acid (DHA) (18:3,n-3 to 22:6,n-3) long-chain polyunsaturated fatty acids (LCPUFA), resulting with one fortified egg attain ≈75% of minimal Daily Recommended Intake (DRI) of n-3 LCPUFA (DHA) for minimal added costs (≈5%). This is especially crucial for women of childbearing age, young children and the elderly for prevention of cardiovascular diseases – and otherwise deficient in the food chain.

Agricultural BF has the potential for significantly upgrading the food chain by adjustments according to regional climate, soil, and population conditions. BF requires regulation and controlled price, to enable affordability and accessibility of BF foods, as a primary tool. BF together with industrial fortification, are critically important for enhancing dietary contribution to nutritional security and public health in Israel and globally to reduce the burden of micronutrient deficiency conditions on health.

Challenges and Opportunities for Food Fortification

Should we Spoon Feed Health - Mandatory Food Fortification or Free Choice?

Boaz Lev; Emeritus Director General of the MOH

Food fortification is a way to add food components that are missing or insufficiently provided by the diet. There are at least four ways to make these nutrients accessible to the public.
Each of these ways has its merits and downsides. Mandatory fortification is the most effective method of making the nutrients reach the desired target since it does not necessitate any behavioral change on the side of the individual - provided we know and understand his intake of foods. The addition of the nutrient is transparent and there is no extra effort by the consumer to achieve the nutrient as provided in the food.

Mandatory fortification regulated and enforced by the government has a downside. This method is fortification across the board through a specified food vehicle and thus is consumed by groups who may not need it or even suffer from untoward health consequences.

On the ethical level it infringes the values of autonomy and freedom of choice while the dilemma is between autonomy and utility- maximizing social benefits.
Alternatives to mandatory fortification are voluntary fortification. This is lead by food industries. While on the choice issue this may be less coercive than mandatory fortification, there might be an inherent conflict of interest since the industry may promote foods with lower health values via claims of beneficial fortification. This may be mitigated by regulation and control over which foods and what claims may be used.

A more targeted method means to fortify by providing supplements such as tablets or other means to be used by those who need these supplements. This method while stronger on the autonomy and choice values is less effective due to compliance issues and the need for personal involvement and action.
Health education and promotion are the most ethical involvements since they respect autonomy and choice yet are the least effective in achieving the targeted population.
The required change in behavior and active choosing may be an obstacle in achieving the level needed for health maintenance.

The role of government is to balance the risks and benefits of each fortifying methodology and weigh the ethical, behavioral and technical issues involved.
A pre-requisite is to gather relevant food consumption and diet composition in order to make decisions and to change them if necessary. A framework to make such decisions lies in implementing methodologies that stem from social justice theories. As an example – John Rawls, in Theory of Justice, suggests the use of "A veil of ignorance" which enables choosing an alternative that is least harmful to all parties involved (The minimax principle).

Risk analysis, social values, behavior and dietary information should be part of the moral equation leading to sound and healthy decisions while avoiding over medicalization of food and adhering to principles of variety, and moderation.

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1. Mark Lawrence Oxford University Press 2013 Food fortification: The evidence, ethics, and politics of adding nutrients to food

2. Theory of Justice - John Rawls ' 1971

Regulatory dilemmas in structuring a new food fortification policy

Anat Chavia Ben-Yosef, Food Control Services and Avidor Ginsberg, Division of Nutrition, Israel Ministry of Health

When introducing food regulations as a whole, a clear separation must be kept between primary and secondary legislation. Food enrichment regulations are handled under secondary regulation and are initiated by the government's Ministry of Health. The regulatory process has several steps, is time demanding and involves many interest holders. This procedure begins at detecting the need for a specific regulation and continues until the final publication in the official journal once the Social Welfare and Labor committee of the Knesset has approved it.

The current regulatory framework on food enrichment involves several food standards, most of which require the enrichment process in order to restore nutrients that may have been lost through the production process. Moreover, there is voluntary enrichment in the food industry, which is yet to be regulated.

While determining food enrichment regulations obvious considerations to the existing legislation have to be made in order to incorporate it For example: the food additives Regulations (some food additives may have a dual function in the food), food labeling regulations which relates to the product's name, nutritional information, nutrition and health claims), food supplements.

The following challenges and dilemmas are required to be taken into consideration while determining local regulations:

1. Determining a suitable approach for Israel, whether voluntary or mandatory, or a combination of the two.

2. Determining vectors, food nutrients and their added amounts based on the nutrition status of the local population in Israel.

3. The future legislation must be based on validated data expressing the lack or excess of food nutrients in the Israeli population.

4. Creating preliminary conditions to ensure the safety of use, including specific production aspects for the enrichment of the food, (mainly dispersion of the food nutrients, and their stability throughout the products shelf life), storage and transportation of food.

5. Development of research and surveys tools in order to constantly maintain and monitoring the effects of the enrichment on the nutrition status of the local population in Israel.

6. Being a food-importing country, may require Israel to justify and scientifically substantiate local requirements for food enrichment in any future trade barriers.

Manufacturer Viewpoint: Salt Iodization in the Israeli Salt Industry

Aliza Ravizki; Research Manager Salt of the Earth Eilat Ltd.

Food fortification is a technological challenge to the food industry, and additionally is a marketing challenge that requires the help of the authorities to increase public awareness to prefer fortified food.

It is now known that salt fortified with iodine was found to be the most cost effective way to reduce the morbidity of disturbances that could occur at any age and are defined as IDD (Iodine Deficiency Disorders). It is essential to remember that severe iodine deficiency can cause overt cretinism, the most extreme form of mental retardation, which is irreversible if occurring in early stages of life.

Salt of the Earth is the leading salt manufacturer in Israel. The company has about 40 years of experience producing iodized salt in various doses, according to the different target countries to which the salt is exported.

The iodine salt fortification in Israel was set to 30 mg of iodine (I-) per kilogram of salt.

The salt production process is a continuous process with high capacity, thus requires sophisticated technological means to ensure an accurate dose of the iodine, to enable fortification with the required iodine content in salt.

Iodine tends to evaporate from the fortified salt over time due to various factors. It is generally accepted that salt storage conditions have great impact on iodine stability, and that moisture and sun exposure are key factors.

In order to maintain dry conditions, free flowing agent (amorphous silica dioxide -E551) is added to the iodized salt increasing the durability of the iodine. Moreover, using KIO3 is a more stable formula than KI as the substance to fortify salt, as it boosts the stability of the iodine.

Salt of the Earth has examined salt fortification with other micronutrients, anti-oxidants, fruit & vegetable extracts and other nutrients, but did not enter into production due to the lack of economic feasibility mainly due to marketing costs.

The public in Israel is unaware of the importance of iodine in nutrition, and does not prefer iodized salt. The company invests in an array of marketing activities to increase public awareness, but the public is not sensitive to health messages coming from the food industry. However, they are attentive to messages coming from health authorities. Therefore it is necessary to have integrated work.

Melach Haaretz voluntarily produces iodized salt for the Israeli market in consultation with the Ministry of Health. The high cost of advertising and creating a market for iodized salt was a major barrier to the use of iodized salt by Israeli households. The industry's unfulfilled expectation was that government would underwrite a marketing campaign.

Panel Discussion

Panel Chair, Prof. Aron Troen; The Institute of Biochemistry Food Science and Nutrition, School of Nutrition, The Hebrew University of Jerusalem

The closing panel discussion responded to the coyly phrased title “Are there prevalent micronutrient deficiencies in Israel 2019? Challenges and opportunities for food fortification"by asking the speakers and audience three questions: 1) Is the presented evidence of prevalent micronutrient deficiencies in Israel credible and concerning?; 2) Would adopting mandatory food fortification as practiced internationally and recommended by MOH committees over the years be a safe and effective measure to alleviate such deficiencies, provided it is adpted to local conditions?; and 3) What are the key barriers and solutions to realizing and implementing the MN committee’s recommendations?

The answer to the first two questions was unequivocally affirmative. In Prof. Dary’s expert opinion the evidence presented on iodine insufficiency and the current rates of neural tube defects alone, are compelling arguments for initiating fortification immediately. He reiterated his view that Israel’s advanced scientific, medical and health capacity provide it with a unique opportunity to become a world exemplar of how to fortify food correctly, provided we learn from international experience and avoid the pitfalls that have weakened or undermined programs elsewhere.

Prof. Hagai Levine (Chair of the Israel Association of Public Health Physicians) stated that failure to proceed with mandatory, regulated food fortification would be irresponsible. Prof. Siegal Sadetzki (Head of Public Health Services at the MOH) agreed, although she noted that the “devil is in the details”. The ensuing discussion highlighted several issues that have hindered previous attempts to advance fortification, and outlined a road map to legislating a sustainable mandatory fortification policy, as recommended by the fortification committee and endorsed by the Deputy Minister of Health and the MOH Director General.

Scientifically, there are no major obstacles to specifying food fortification standards for Israel. The MABAT national health and nutrition surveys provide the necessary data to both determine the prevalence of deficient micronutrient intake, and to model how adding a given amount of a micronutrient (i.e. folic acid) to a vehicle food (i.e. flour), can deliver safe and effective increases in the population’s intake of the required nutrients. Such models must account for the distribution of micronutrient intake from food, supplements and voluntarily fortified foods in the target and vulnerable populations, and identify the gap between the current and desired intake levels.

The population’s intake of the intended vehicle is subsequently analyzed and used to calculate the optimal amount of micronutrient that can be added to the vehicle to safely and effectively improve intake in the target population without risk of excessive intake in other population subgroups. Specifying those foods that may and may not be fortified can also improve the safety profile of fortification programs by avoiding unanticipated and uncontrolled introduction of supplemental micronutrients into the food supply.

Although the MABAT surveys describe dietary *intake* they do not evaluate biomarkers of nutritional *status*. Ascertaining the prevalence of inadequate status is important both to motivate action and to

provide a baseline against which the effectiveness and safety of fortification can be monitored. Until they do, existing health services can provide essential data. For example, as with the recent national iodine survey, national birth registries, sick fund laboratories, and electronic databases can be used for surveillance of sentinel populations. Use of such Big Data sets provide for feasible and cost-effective monitoring of the impact of fortification on nutritional status and related health outcomes. Funding will need to be appropriated for this purpose.

The technological hurdles are also minimal. Israel's food industry and supply chain has all the attributes that are necessary to provide for effective mandatory food fortification, including centralized manufacturing and milling and excellent technological expertise and capacity. Indeed, Israeli firms already export fortified salt and flour to the Palestinian Authority and offer a small line of voluntarily fortified products to the Israeli market at a premium price.

Aliza Ravitsky, of the *Melach Haaretz* salt company, described how *Melach Haaretz* voluntarily produces iodized salt for the Israeli market in consultation with the Ministry of Health. She identified the high cost of advertising and creating a market for iodized salt as a major barrier to the use of iodized salt by Israeli households, and signaled industry's expectation that government would underwrite a marketing campaign. Nevertheless, despite the negligible cost of iodization, the retail price of iodized salt is typically 4 – 12 times higher than that of regular price-controlled table salt. The unintended result is that government economic policy actually *discourages* the use of iodized salt.

International experience shows that when iodized salt and fortified food is sold at a premium, it increases health disparities because the less affluent households and food-insecure households that are most in need are less likely than more affluent households to purchase fortified foods. Moreover, advertising iodized salt as a healthful alternative to regular salt runs counter to the public health interest of reducing sodium intake. It also opposes the inherent logic of mandatory food fortification, which benefits the public's health by increasing nutrient intake without changing behavior. In short, the *status quo* favors voluntary, market-driven fortification, at the expense of public health, and is therefore untenable.

Thus, the main impediments to mandating fortification are neither scientific nor technological. Rather, the challenge has been to draft and pass legislation designed to regulate, enforce and fund fortification, according to the specific health and nutrition needs of the Israeli population. The decades-long failure to do so partly reflects concern over those significant regulatory, budgetary and political efforts that are necessary to give public health priority over competing interests.

WHO guidelines on food fortification along with extensive international experience are important in support of the new Israeli policy; they help to reassure and guide Israel's response to these concerns. In fact, the first step of setting standards for fortified foods is already underway. At the urging of the MOH, the Israel Standards Institute has already begun to revise the salt and milk standards for fortification with iodine, calcium and vitamin D. However, the MOH Nutrition Division has only formal modeled the impact of fortification on intake for iodized salt, and targets for fortifying Israeli milk with vitamin D, and flour and bread with folic acid, vitamin B12, iron and other micronutrients remain to be completed.

Once ratified, new food standards will allow food producers and importers to market fortified foods and label them as such. Theoretically, such market-driven, voluntary fortification might improve the dietary

intakes of some Israelis, but extensive international experience shows that uncontrolled voluntary fortification is less effective, more prone to promote risk of excessive intake and more likely to increase health disparities than mandatory (compulsory) and controlled food fortification. Indeed, the failure of voluntary salt iodization to prevent population iodine insufficiency in Israel is typical. Thus, it is crucial that in addition to revising the food standards, Israel enacts corresponding regulations following the "Canadian model" approach of specifying those food vehicles that must, may, and may not be fortified.

Another concern flagged by the MOH Food Services is that mandatory fortification might restrict free trade, particularly with Europe. But in fact, the World Trade Organization allows countries to create their own national food standards in accordance with the CODEX Alimentarius, and to legislate mandatory fortification of locally produced and imported food, when required for public health. Indeed, the European Union does not require harmonized food standards. Rather, each European Member State regulates fortification based on the health needs of its own population. For example, of the 25 EU member states, 7 have compulsory enforcement of iodized salt use. Ten EU member States permit iodide (KI or NaI) only, two permit iodate (KIO_3) only, and 9 permit both iodide and iodate. Furthermore, the required iodine concentrations differ between member states based on each population's iodine status, and none of this prevents European trade. Simply stated, trade considerations do not trump mandatory fortification, provided the legislation is necessary to ensure public health.

Finally, the panel discussed the ethical issues raised by Prof. Boaz Lev, who was unable to advance fortification during his tenure as MOH Director General, and who framed the choice of mandatory over voluntary fortification in terms of paternalism vs. autonomy. While the panel supported the effectiveness and safety of fortification, there was not time to fully discuss the ethical justification for mandatory fortification.

Nevertheless, Prof. Ilana Belmaker, a public health physician from the audience, argued forcefully for the notion that the concept of autonomy includes state protection for those individuals whose choices are limited due to their economic and social circumstances, such as those most in need of mandatory fortification. Similarly, Prof. Ted Tulchinsky made a compelling case for the moral imperative for the State to protect the lives and wellbeing of its citizens who would otherwise suffer the consequences of the silent hunger of micronutrient deficiencies.

Permanently eliminating prevalent micronutrient deficiencies in Israel along with their grievous consequences will require perseverance and determination. This conference demonstrated that the MOH has the backing of national and international public health and nutrition professionals to do what is necessary to end silent hunger of micronutrient deficiencies through fortification, in the framework of a comprehensive national nutrition strategy.

The Conference supported the policy of food fortification as presented by Prof Endevelt. The MOH Public Health Services must include the drafting of fortification legislation in the MOH annual work plan; update cost utility analyses; make administrative arrangements to sustain fortification; establish a steering committee with a mandate to design, oversee and enforce the program; and provide for the periodic monitoring of the population's nutrient intake and status.

The MOH must continue to place public health over competing interests and resist political pressures that threaten to weaken and undermine effective and responsible policy. Doing so will ultimately

improve the wellbeing of the Israeli public, by helping to lessen health and social disparities, reduce health system costs to the Israeli economy and prevent the tragic waste of unrealized human potential from preventable deficiency conditions prevalent in Israel. The time to act is now.

Conference Conclusions: The Way Forward

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Conference participants applauded the leadership of Profs. Sadetzki and Endevelt in rigorously evaluating the need for food micronutrient fortification and the policy alternatives to meet this pressing need.

The clear demonstration of prevalent preventable micronutrient deficiencies and their adverse health consequences necessitates urgent, decisive and sustained action on the part of the Ministry of Health in collaboration with other relevant Government agencies, to remedy the situation.

Achieving a sustainable fortification policy, backed by the necessary legislation and appropriations, to regulate, monitor and enforce fortification, requires that the MOH urgently fulfill the recommendations of the committee on food fortification, which were presented by Prof. Endevelt at the conference, and which have been endorsed by the Director General of the MOH, Mr. Moshe Bar-Siman Tov and by the Deputy Minister of Health, MK Yaakov Litzman.

The committee recommendations specified the following concrete steps:

Section I. Excerpted from the Executive Summary:

…The Committee finds that sustainable policies should be implemented to ensure proper nutrition and to prevent deficiencies in essential trace elements. One option for implementing this policy is by fortifying foods in nutrients that are deficient in the Israeli population, according to the World Health Organization recommendations and in line with the mandatory food enrichment model in Canada. The Committee recommends that this policy be implemented under certain conditions and in selected food products, but only if there is a system capable of monitoring, surveilling and regulating fortification and its effects on public health.

Regular periodic monitoring of micronutrient levels is absolutely essential to ensure that the target micronutrient levels are attained, and to periodically adjust fortification levels as required by advances in scientific knowledge advancement and changes in the public's dietary habits over time. At the same time, [current] regulations must be updated to prohibit the voluntary and uncontrolled supplementation of processed foods to avoid exposing the public to nutritional excess .

The [MOH] Nutrition Division should be budgeted so that it can monitor the population's vitamins and minerals in a controlled and random manner every two or three years. In addition, positions should be created in the Nutrition Division for staff who will be dedicated to the fortification and will be in contact with international institutions who deal with fortification.

In addition, a dedicated budget is needed so that additional foods can be fortified as needed if indicated by periodic testing.

It is already evident that significant parts of the population are deficient in iodine, vitamin D, calcium magnesium and folic acid and B12 and it is important to have a reliable surveillance system so that when

these nutritional components are added to fortified foods, [the program] can be monitored and adjusted accordingly.

In addition, the regulations governing nutritional supplements must be revised in accord with current RDAs.

Section V. Discussion, Conclusions and Recommendations of the Full Committee:

1. Food Fortification Policy should be implemented in Israel based on:

a. National surveys of all kinds and from various sources (including from the "Gertner Institute" (The Gertner Institute includes The Israel Ministry of Health Center for Disease Control and the Israel National Institute for Health Policy and Health Services Research)

b. Data from all health funds, including the largest health fund in the country – the Clalit health fund, which covers about half of the state's population, from which we have no data to date. This issue needs further consideration, as most of the available data are for sick people and the [lab] norms are related to patients rather than healthy populations.

c. Results of various studies conducted in academic and medical centers in the country (eg the urinary iodine survey. It should be noted that [the available data] from some academic studies are not representative of the general population.

d. Routine monitoring of population nutrition once every 3 years

2. The committee recommends first fortifying table salt and salt used for baking bread with iodine and milk and milk-substitutes with vitamin-D and also recommends considering fortifying flour with iron, folic acid, vitamin B12, magnesium and calcium.

3. The Committee recommends that an international expert committee be established to accompany the enrichment process in Israel and teach the Ministry of Health how to implement the process from start to finish, including decision making, and routine monitoring.

4. The Committee recommends collaborating with the Ministry of Agriculture to encourage Biofortification. Using this approach the soil can be improved and enriched with missing nutrients in order to fortify the crops grown on this soil with these nutrients.

5. The Committee recommends prohibiting the voluntary enrichment of specific foods, such as sweets, sweetened cereals, snacks and more, as per the Canadian fortification policy. The situation today [in Israel] is "wild" [unregulated] enrichment of many food products, with no oversight or nutritional justification: Numerous products are supplemented with a variety of nutritional components and in amounts that are not always clearly indicated.

6. The Committee recommends allocating the necessary budget to the Nutrition Division so that it may conduct regular monitoring and surveillance, as well as regular updating of the Israel Foods database, including laboratory testing of Israeli food. Monitoring and surveillance will be required once the type of fortification to be carried out is decided upon. A regular process of periodically conducting monitoring, nutritional surveys including blood tests and updating the food database is needed.

7. The Committee recommends establishing a unit in the Nutrition Division to conduct regular monitoring and surveillance of fortification, by recruiting nutritionists who will [specialize in fortification] and maintain contact with centers abroad and will study the issue to ensure its implementation and regular monitoring of the issue.

8. The Committee recommends providing multi-year funding over an extended period as needed to build a national food fortification program so that monitoring, surveillance, follow-up, mathematical fortification modeling, technical solutions and support, consultation with international experts, surveys, research studies and laboratory testing can all be performed .

9. Regulations - The Committee recommends that [the responsibility for] food fortification be transferred immediately from the Israeli Standards Institute to the Ministry of Health so that regulations may be set which specify internationally recognized dietary allowances .

10. The Committee also recommends that the question of dietary supplements should be evaluated and the regulations should be updated such that they comport with the RDA values ."

Considerable progress has already been made since the report was submitted to the Ministry, but much work remains to be done.

The MOH Nutrition Department and Food Services have conducted an initial Regulatory Impact Assessment (RIA) and have begun the process of modelling the predicted impact on the population nutrient intake of fortifying salt milk and flour with their respective fortificants (i.e. iodine for salt, calcium and vitamin D for milk, and folate and other nutrients for bread and flour).

Under the advisement of the MOH, the Israel Standards Institute in in the midst of updating the food standards for salt and milk to allow their fortification and specify the permitted and required levels of fortification.

The regulatory barriers presented by Ms. Ben-Yosef of the MOH Food Services department and referenced in her abstract above, are largely technical in nature and can be readily resolved. A recently published international comparison of food fortification regulations and checklist for preparing legislation has been provided to guide the MOH in their efforts (eg. Marks KJ, Luthringer CL, Ruth LJ, et al. Review of grain fortification legislation, standards, and monitoring documents. Glob Health Sci Pract. 2018;6(2). https://doi.org/10.9745/GHSPD-17-00427).

Optimal solutions for Israel should be justified based on extensive international experience and the prevailing local conditions: First, extensive international experience clearly shows that the most suitable solution for Israel is to legislate mandatory food fortification following the framework of the Canadian regulations, as specified in the committee recommendations. Second, the committee identified the food vehicles and nutrients to be fortified as a first priority. Third, as presented at the conference, sufficient, valid data exist to provide the distribution of deficient and excess intakes and status in the population, to justify and design the fortification program.

These data also justify the need for fortification both internally and to the World Trade Organization, which permits the application of local standards to imported foods when it is needed to ensure the populations health. And the data also allow for the calculation of safe and effective targets for

fortification given intake data for both the vehicle and the fortificants in the target and general population that will reduce the proportion of the target populations suffering from inadequate intake, while avoiding excessive intakes in others.

The issue of human biomonitoring in Israel is currently being evaluated by the Environmental Health Fund and MOH with respect to harmful exposures. Routine, periodic nutritional monitoring must be incorporated into any governmental plans to enhance current biomonitoring capacity and funding should be allocated within the government or through competitive grants to ensure that the populations' nutritional status can be regularly and reliably ascertained.

As noted above, economic cost-utility analyses from around the world have established the exceptionally high benefit/cost ratio of food fortification. Current estimates should be developed for Israel based on local deficiency rates, health indicators and health costs, to enhance the political will and sustainability of the programs and to encourage their funding.

In the process of drafting the legislation, the MOH should solicit support from all interested stakeholders to establish a "fortification coalition". Local and international experts can contribute to the design and implementation of the program, as was the demonstrated by this conference. Industry cannot be expected to comply voluntarily with fortification, but once the framework is set, the MOH will need to consult on the optimal implementation and work with industry to ensure that quality controls can be met and the regulations enforced. The academy, medical professions, health care sector, consumer groups and media can play a vital role in educating the public and building support for the policies.

In conclusion, three key conditions must be met to achieve the goal of sustainable mandatory fortification in Israel: maintaining political support, creating necessary administrative arrangements and ensuring sustained assessment and follow up monitoring. Committed MOH leadership and stakeholder cooperation will be vital to achieve this. We call for a follow-up conference in about one year to maintain continued support for implementation and monitoring progress and barriers to secure this critical component of a nutritious health-promoting, safe sustainable and equitable food supply for all the citizens of Israel.

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