

Evidence brief for policy

EVIPNet Europe

Number 7

Reducing the consumption of trans-fats and their
negative impacts on health in Turkey



Hakan Oğuz ARI
Elif İŞLEK
Yonca ÖZATKAN
Merve Kardelen BİLİR
İlkem DEMİRKESEN MERT
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ABSTRACT

Trans-fatty acids (TFAs), or trans-fats, are an important public health problem that has many negative consequences for human health and requires multi-stakeholder health policy interventions for its solution. TÜSEB Turkish Institute for Health Policies, the Ministry of Health of Turkey and the WHO Country Office in Turkey came together to develop this evidence brief for policy, to be published under the aegis of the WHO European Evidence-informed Policy Network, to provide evidence-informed options for policy-makers to tackle the problem of reducing the consumption of TFAs in Turkey. The work was carried out within the framework of the collaboration between TÜSEB Turkish Institute for Health Policies and WHO; it involved the Ministry of Health of Turkey, high-level national policy institutions and national experts, and was supported by technical experts from the WHO Regional Office for Europe. TÜSEB Turkish Institute for Health Policies convened a working group comprising representatives from the clinical field, the Ministry of Health and the Ministry of Agriculture and Forestry. The group identified, selected, appraised and synthesized relevant research evidence on the problem; devised three options for tackling it; and weighed up considerations in implementing each option. The three options are: (1) Establishing mandatory limits on TFAs; (2) Labelling TFA-free foods and raising awareness of the health effects associated with TFAs; and (3) Introducing incentives to replace industrially produced TFAs with healthier oils and fats.

KEYWORDS

Trans-fats
TFAs
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AUTHORS

Hakan Oğuz ARI, MSc, Expert at TÜSEB Turkish Institute for Health Policies, Ankara, Turkey

Elif İŞLEK, MSc, Expert at TÜSEB Turkish Institute for Health Policies, Ankara, Turkey

Yonca ÖZATKAN, MSc, Expert at TÜSEB Turkish Institute for Health Policies, Ankara, Turkey

Merve Kardelen BİLİR, MSc, Health Officer at Haydarpaşa Numune Training and Research Hospital, Ankara, Turkey

İlkem DEMİRKESEN MERT, PhD, Food Engineer at Ministry of Agriculture and Forestry, Ankara, Turkey

Elif Hande ÖZCAN ÇETİN, MD, Specialist in Cardiology at Ankara City Hospital, Ankara, Turkey

Professor Hasan Hüseyin YILDIRIM, PhD, Director at TÜSEB Turkish Institute for Health Policies and Professor at University of Health Sciences, Ankara, Turkey

Professor Toker ERGÜDER, MD, PhD, Programme Coordinator at WHO Country Office in Turkey and Professor at University of Health Sciences, Ankara, Turkey

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ABBREVIATIONS

AMSTAR	A MeaSurement Tool to Assess systematic Reviews
CHD	coronary heart disease
CVD	cardiovascular disease
DALY	disability-adjusted life year
EBP	evidence brief for policy
EVIPNet Europe	Evidence-informed Policy Network Europe
HDL	high-density lipoprotein
LDL	low-density lipoprotein
MUFA	monounsaturated fatty acid
MUMSAD	Kitchen Products and Margarine Industrialists Association
NCD	noncommunicable disease
PHVO	partially hydrogenated vegetable oil
PUFA	polyunsaturated fatty acid
R&D	research and development
SFA	saturated fatty acid
SSB	sugar-sweetened beverage
TFA	trans-fatty acid
TGDF	Federation of Food and Drink Industry Associations of Turkey
TUBITAK	Scientific and Technological Research Council of Turkey
TUIK	Turkish Statistical Institute
TURDEP	Turkish Epidemiology Survey of Diabetes, Obesity and Hypertension
TÜSEB	Health Institutes of Turkey
TÜSPE	Turkish Institute for Health Policies

MAIN MESSAGES

The problem

Trans-fatty acids (TFAs), or trans-fats, which are classified as naturally existing or industrially produced, are unsaturated fatty acids. TFAs have negative health effects, such as cardiovascular disease (CVD), hypertension, obesity, cancer, infertility and diabetes. Turkey has also been struggling with a large and growing burden of noncommunicable diseases (NCDs) and obesity problems. Therefore, the elimination of TFAs from the global food supply on a global scale is a priority goal of the current strategic plans of WHO and the Ministry of Health of Turkey.

TFAs are an important public health problem that has many negative consequences for human health and requires multi-stakeholder health policy interventions for its solution. The elimination of industrially produced TFAs from food is a vital issue that can be implemented using appropriate policy tools, has alternative solutions and is of vital importance.

Evidence from systematic reviews and other sources on the proposed policy options

○ Option 1. Establishing mandatory limits on TFAs

- Mandatory regulations have been evaluated as the most effective policy intervention for decreasing intake of TFAs from foods and thus reducing the health risks to consumers.
- The success of mandatory regulations requires both political awareness and commitment.
- Good compliance among different stakeholders is essential for mandatory regulations to succeed.

○ Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs

Labelling TFA-free foods

- Food labelling has the potential to help consumers make more informed decisions in their food purchasing and nutrition.
- Exposure to food labels is associated with improved nutrition and nutrition labels positively affect dietary quality.

Raising awareness of the health effects associated with TFAs

- Raising awareness of the negative health effects of TFA consumption is a significant component of TFA elimination programmes. More upstream interventions, including banning TFAs in foods and mandatory labelling, have an impact on the applicability and success of the strategies.

- A combination of public awareness campaigns with mandatory labelling, reformulation of products and TFA bans is the key to success.
- **Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats**
 - Reformulation of products appears to be an effective option in reducing the TFA content in food and dietary intake.
 - Reformulation has a positive impact on reducing the risk of CVDs.

Implementation considerations

- » Cultural factors that affect eating habits should be emphasized in order for the policies that are implemented to succeed.
- » Providing incentives for smaller-scale producers to reformulate their products is critical to reducing the TFA content in products.
- » Families and educational institutions can be encouraged to promote awareness about the importance and benefits of food labelling, especially for children and young people, by sharing their experiences and motivating each other.
- » Multicomponent interventions can facilitate successful implementation of the regulations.
- » Financial support may be provided for research and development (R&D) projects on the collection and recycling of waste oils as fuels and vehicle waste oil management.

EXECUTIVE SUMMARY

Trans-fatty acids (TFAs), or trans-fats, can be naturally present in food products derived from ruminant animals, but the concentration of TFAs in dairy and meat fats is usually low (3–8%). Industrially produced TFAs are the result of an industrial process that includes hydrogenation of vegetable oil, which in most cases aims to convert liquid fat into a semi-solid. Accounting for the majority of TFAs consumed, the concentration of industrially produced TFAs varies from 10% to 50% based on the production technology.

TFAs have negative health effects, such as cardiovascular disease (CVD), hypertension, obesity, cancer, infertility and diabetes. Therefore, elimination of TFAs from the global food supply on a global scale is a priority goal of the current WHO strategic plan.

As a densely populated country with an estimated population of 83 million people, Turkey has been struggling with a large and growing burden of NCDs. CVD ranks first among these, while obesity is becoming an increasingly important public health problem in the childhood population in Turkey. Although data on the specific consequences of TFA consumption are scarce, considering the link between TFA intake and CVD and its associated risk factors, we may hypothesize that TFA intake could be one of the main predisposing factors for CVD. It is apparent, therefore, that elimination, or at least reduction, of TFAs is an appropriate intervention to achieve desirable health goals in the area of CVD.

Three options to address the problem of eliminating or reducing TFAs were selected: (1) Establishing mandatory limits on TFAs; (2) Labelling TFA-free foods and raising awareness of the health effects associated with TFAs; and (3) Introducing incentives to replace industrially produced TFAs with healthier oils and fats.

Selected options for addressing the problem

Option 1. Establishing mandatory limits on TFAs

- » Mandatory regulations have been evaluated as the most effective policy intervention for decreasing intake of TFAs from foods and thus reducing the health risks to consumers.
- » The success of mandatory regulations requires both political awareness and commitment.
- » Good compliance among different stakeholders, including the agriculture sector, food industry, policy-makers, legislative and other relevant commissions, and the media, is essential for mandatory regulations to succeed.
- » Governments have the power to decrease the average population consumption of industrially produced TFAs because the availability of TFAs in the food supply is reduced by the specific legislation.

Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs

Labelling TFA-free foods

- » Food labelling has the potential to help consumers make more informed decisions in their food purchasing and nutrition, and it puts pressure on the food industry to reformulate food.
- » Exposure to food labels is associated with improved nutrition and nutrition labels positively affect dietary quality.
- » Food labelling reduces consumer dietary intake of selected nutrients and influences industry practices to reduce the product content of sodium and industrially produced TFAs.

Raising awareness of the health effects associated with TFAs

- » Raising awareness of the negative health effects of TFA consumption is a significant component of TFA elimination programmes. More upstream interventions, including banning TFAs in foods and mandatory labelling, have an impact on the applicability and success of the strategies.
- » TFA reduction has been achieved in several high-income countries through a combination of public awareness campaigns with mandatory labelling, reformulation of products and TFA bans.
- » Sustained, dedicated media and educational campaigns, using multiple channels focused on reducing consumption of specific unhealthy foods, can be effective.
- » The major step in raising awareness of health issues is to improve nutrition education strategies (public awareness campaigns, education in specific settings, skills training, changes in the food environment) with the main goal of changing behaviour.
- » Multicomponent interventions may be more effective than single interventions.

Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats

- » Reformulation of products appears to be an effective option in reducing the TFA content in food and dietary intake.
- » Reformulation has a positive impact on reducing the risk of CVDs.
- » Food labelling may create “social pressure” on manufacturers to use reformulation strategies, while presenting opportunities to consumers to choose and purchase healthier options.
- » It has been highlighted that the use of cost-effective alternatives in products will require extensive engagement with industry.

Considerations in implementing the three options

The authors of the current brief considered possible opportunities for and barriers to implementation. The socioeconomic situation of an individual, individual behaviours and food preferences form a potential barrier to implementing mandatory limits on TFAs. In Turkey, bakery products, cookies, biscuits, bagels (*simit & poğaçça*), cakes, etc., which are sold without packaging and labels, occupy an important place in the eating habits of every age group. Thus, bakery products, fast-food markets and street food vendors constitute a barrier to implementing mandatory limits on TFAs because of their place in the food sector and consumers' food preferences. Monitoring and evaluating the imposition of mandatory limits on TFAs is another barrier to be considered. In Turkey, despite voluntary engagement on the part of some industrial societies in TFA reduction strategies, there are still a large number of producers and consumers who are not aware of the negative health impact of TFAs, the definition of TFAs, and the extent of exposure to TFAs. Therefore, cultural factors that affect eating habits should be emphasized in order for the policies that are implemented to succeed.

In order to obtain the greatest health benefits from reformulated products, it has been suggested that TFAs should be replaced with vegetable oils that have higher amounts of unsaturated fatty acids, rather than with tropical oils such as palm oil, which are rich in saturated fatty acids (SFAs). The impetus for product reformulation often comes from consumers who value and demand products that are low in TFAs. For this reason, it is suggested that strategies should be used that improve awareness about TFAs, especially in different ethnic or socioeconomic subgroups. It is also important to make a wider range of reformulated products available for consumers. Thus, government policy and actions are required that lead not only to reduction in TFAs but also to greater variety in food products. In Turkey, as a result of cultural habits as well as lack of auditing, bakery products (which are generally unpackaged products sold in small shops and on the street) have the highest TFA content. Providing incentives for smaller-scale producers to reformulate their products is therefore critical in reducing the TFA content in products.

At the same time, there are various opportunities presented by implementation of the three options that should be considered.

In the context of Turkey, the food industry may facilitate the implementation of mandatory limits on TFAs, which may be considered a potential opportunity. Mandatory limits on TFAs also create a potential opportunity to inform the public about the negative health impact of industrial TFAs, using the limiting legislation as a springboard to promote healthier lifestyles. Communication and cooperation with key stakeholders in the public sector are crucial to support implementation of the planned arrangements. It is also important to consider dialogue with industry representatives in order to ensure successful implementation of the policies and to increase the level of compliance with the regulations to be applied in the food production sector. Raising awareness about TFAs among senior policy-makers is another important step in successfully implementing TFA elimination policies. It is also important for successful implementation that prominent people known to have influence in society take part

in information and public awareness campaigns. Food labelling accelerates reformulation of products by putting pressure on producers and so has the effect of decreasing the TFA intake levels of individuals. Therefore, it is thought that implementation of the food labelling option with the support of the food industry can be implemented quickly. Families and educational institutions can be encouraged to promote awareness about the importance and benefits of food labelling, especially for children and young people, by sharing their experiences and motivating each other.

Some trade associations are also playing a role in the collaboration between industry and government agencies. Such multicomponent interventions can facilitate successful implementation of the regulations.

In Turkey, there are several financial opportunities available for researchers to develop reformulations as well as for use of new techniques in products. For example, the Scientific and Technological Research Council of Turkey (TUBITAK) has several programmes and funds available to provide financial support for R&D projects. In addition, public institutions and government bodies have R&D budgets. These resources can be used as incentives to encourage advanced research in the field of creating alternatives to TFAs. Financial support may also be provided for R&D projects on the collection and recycling of waste oils as fuels and vehicle waste oil management.

The present evidence brief for policy (EBP) was produced to support Turkish policy-makers and other decision-makers in formulating evidence-informed policies, strategies and interventions. The background to the development of the EBP is described in Box 1.

Box 1. Background to the evidence brief for policy

The present evidence brief for policy (EBP) mobilizes both global and local research evidence about a problem, devises three options for addressing it, and evaluates key implementation considerations. Whenever possible, the EBP summarizes research evidence drawn from systematic reviews. A systematic review is a summary of studies addressing a clearly formulated question that uses systematic and explicit methods to identify, select and appraise research studies and to synthesize data from the studies included. Single studies, grey literature (such as reports and guidelines) and relevant datasets were also considered.

The EBP does not contain recommendations. The three options discussed are intended only as possible ways of developing policy, supported by strong scientific evidence. They could be pursued simultaneously or elements could be drawn from each option to create a new one. The three options were selected because together they address a large spectrum of causes of the problem.

Nine steps were taken in preparing the EBP:

- (1) selecting a topic;
- (2) convening a working group comprising representatives from the clinical field, the Ministry of Health, the Ministry of Agriculture and Forestry, and the Turkish Institute of Health Policies (TÜSPE) team;

- (3) conducting a workshop on evidence-informed policy-making methodology (as the working group);
- (4) developing and refining the terms of reference for the EBP, particularly the framing of the problem and the options for addressing it;
- (5) determining key informants and the steering committee;
- (6) identifying, selecting, appraising and synthesizing relevant research evidence on the problem, options and implementation considerations;
- (7) interviewing key informants about local implementation considerations;
- (8) drafting the text to present, in concise and accessible language, the global and local research evidence; and
- (9) finalizing the EBP based on the input of several merit reviewers.

The EBP was prepared to inform a policy dialogue in which research evidence is one of many considerations. Participants' views and experiences and their tacit knowledge of the issues at hand are also important inputs to the dialogue. One goal of the policy dialogue is to spark insights – insights that can only arise when all of those who will be involved in or affected by future decisions about the issue can work through it together. A second goal of the policy dialogue is to generate action by participants in the dialogue and those who review the dialogue summary.

THE PROBLEM OF CONSUMPTION OF TRANS-FAT

Trans-fats or trans-fatty acids (TFAs) are unsaturated fatty acids which are classified as naturally existing or industrially produced. Naturally occurring TFAs are produced by the gut bacteria of ruminant animals such as cattle, sheep and goats, while industrially produced TFAs are the result of an industrial process that includes hydrogenation of vegetable oil, which in most cases aims to convert liquid fat into a semi-solid. The main mechanism used in the industrial production of TFAs is the partial hydrogenation process (WHO, 2015). There are no known health benefits of TFAs, but several negative consequences, including cardiovascular disease (CVD), hypertension, obesity, cancer, infertility and diabetes, have been described (Willet & Ascherio, 1994; NCD Alliance, 2019). TFAs can be replaced in foods without affecting consistency or taste. Elimination of TFAs from the global food supply is a priority WHO target (NCD Alliance, 2019). Accordingly, the WHO policy brief recommends limiting total TFA (industrially produced and ruminant) to no more than 1% of total energy for both adults and children (WHO, 2015).

How the problem came to our attention

The problem came onto the agenda, attracting the attention of policy-makers, in line with the objective of encouraging and improving healthy eating habits in order to promote healthy living in the strategic plans of the Ministry of Health of the Republic of Turkey covering the periods 2013–2017 and 2019–2023 (Ministry of Health, 2012 and 2019). The 10th and 11th development plans, which are important documents in the policy agenda, have also set goals and targets for healthy eating and healthy living. The Healthy Life and Physical Activity Programme was implemented within the scope of the 10th Development Plan (2014–2018) (Ministry of Development, 2013). The aim of this programme was to improve food safety and enhance preventive health and mental health services by combating unhealthy diet, sedentary lifestyle, tobacco use, and alcohol and substance abuse. Within the scope of the recently published 11th Development Plan, covering the years 2019–2023, policies and measures will be developed to tackle issues such as food safety, obesity and environmental health for the multi-stakeholder health responsibility model (Presidency of Strategy and Budget, 2019).

The elimination of TFAs from the global food supply on a global scale is a priority goal of the current WHO strategic plan. This objective is also considered an effective and cost-effective policy measure with a life-saving potential (WHO, 2018a).

In order to encourage healthy eating habits and thus promote healthy living, some of the issues highlighted by both WHO and the Ministry of Health of Turkey are: to reduce consumption of TFAs, high sugar and salt-containing products by introducing price policies, decreasing portion sizes, and making arrangements to limit advertising of such foods; to develop a cooperation platform with food producers and suppliers to produce healthier foods; and to introduce a front-side colour labelling system that is easier for the consumer to understand.

The issue of reducing the use and consumption of TFAs was brought up at the Multi-Stakeholder Health Policies Executive Board meeting, which was held in 2018 and organized by the Ministry of Health with the participation of relevant ministry and other officials. At this meeting it was emphasized that consumption of TFAs constituted a major problem for society. At another meeting, organized by the Ministry of Agriculture and Forestry of the Republic of Turkey, plans were drawn up to make the necessary legislative changes to ensure that the content of TFAs (other than TFAs naturally occurring in fat of animal origin) in food intended for the final consumer and for supply to retail should not exceed 2 g per 100 g of fat; this has recently been reflected in new legislation ([Official Gazette, 2020](#)).

Finally, at the WHO Evidence-informed Policy Network (EVIPNet) Europe multicountry meeting held in Istanbul, Turkey, on 3–5 September 2019, various aspects of the issue were discussed ([WHO, 2019a](#)). As a result of the deliberations between WHO EVIPNet Europe, the WHO Country Office in Turkey, the relevant technical unit of the WHO Regional Office for Europe, the Ministry of Health of the Republic of Turkey and the Presidency of the Republic of Turkey Health and Food Policies Council, the Turkish Institute for Health Policies (TÜSPE) began to prepare a report containing possible policy options to address the problem.

Extent of the problem

The amount of industrially produced TFAs in food is generally higher than that of naturally occurring TFAs, and in most countries they are the main dietary source of TFAs. In the WHO European Region, study results from 20 countries showed that, in 396 out of 598 samples of biscuits, cakes and wafers (products with “partially hydrogenated vegetable oil” or a similar term high on the list of ingredients), there was a TFA content of more than 2 g/100 g fat ([WHO, 2015](#)).

There is a wide variety of sources of TFA in the diet, including industrially produced and packaged foods, unpackaged products, food in restaurants, fast food, products of the bakery industry and homemade products. According to a Health Institute Association study in Turkey, potential TFA sources included packaged and traditional cakes and desserts, traditional baked goods and other savoury puff pastry products, packaged cheese-based desserts, margarine, pizza, French fries and chips ([WHO, 2019b](#); [Health Institute Association, 2019](#)).

The Turkish Cardiology Association and the Health Institute Association conducted another survey of the TFA content of various food items by analysing 71 packaged and unpackaged food samples and found TFA levels of more than 1 g in 13% of food items. By contrast, some bakery products, margarines, dairy products, frozen foods and snacks contained less than 1% TFA ([Health Institute Association, 2019](#)). [Demir & Tasan \(2019\)](#) analysed 29 different food brands labelled “trans-fatty acid-free” and found that, with the exception of one item, they complied, in terms of TFA content, with the Turkish Food Codex food labelling and nutrition labelling rules.

A study comprising 134 samples that were categorized as meat products, chocolates, bakery products and others showed that meat products had an average TFA content, arising from bacterial activity in ruminants, of 1.45 g/100 g, while nationally produced chocolate bars and

hazelnut cocoa cream had TFA levels of 2.03 g and 3.68 g/100 g, respectively. Bakery products had the highest content of TFAs, ranging from 0.99 g to 17.77 g/100 g (Karabulut, 2007).

Homemade food is one of the most important TFA sources in Turkey. Butter and margarine are mostly used in rice/pasta (35% and 16.2%, respectively), in soups (15.2% and 4.9%), and in pastry and pastries (10.3% and 21.1%) (Ministry of Health/Hacettepe University, 2014). In the literature, many studies have shown that formation of TFA during frying is closely associated with high temperatures as well as oil use time. Elevated concentrations of TFAs in fried food can be observed if the oil initially contained a high level of TFAs (Martin et al., 2007). Studies have also shown that TFA formation can occur if the heating temperature is above 200 °C (Li et al., 2012). In Turkey, according to the Regulation on Special Hygiene Rules for Solid and Liquid Oils Used in Frying, oil frying temperature should not exceed 180 °C in industrially produced foods (Official Gazette, 2012). In a local study conducted in Turkey, 69.4% of participants were found to fry food 1–2 times a week, while 52% used oil for frying twice (Cirikoglu, 2018). It is clear, therefore, that household kitchens may be an important focus for attempts to control TFA levels in food.

Consequences of the TFA problem

Consumption of TFAs in large quantities has negative effects on public health and is implicated in many noncommunicable and diet-related diseases. It is a significant risk factor for noncommunicable diseases (NCDs), especially CVDs, hypertension, obesity, cancer, infertility and diabetes (Willet & Ascherio, 1994; NCD Alliance, 2019). According to WHO, NCDs cause 41 million deaths each year, representing 71% of all deaths globally. Among NCDs, deaths from CVD are the highest, affecting 17.9 million people per year – almost twice the number of annual losses in the Second World War (WHO, 2018b). Although there is limited information on TFA intake, about 540 000 deaths are estimated to be attributable to high levels of TFA intake each year, while approximately 4000 deaths were estimated for Turkey in 2010 (Wang et al., 2016).

Evidence of the detrimental health effects of TFA consumption has stirred strong public interest, as CVD remains the leading cause of mortality and the rate is increasing steadily in spite of emerging therapeutic developments (Mozaffarian et al., 2009; De Souza et al., 2015). It is apparent, therefore, that elimination, or at least reduction, of TFAs is an appropriate intervention to achieve desirable health goals in the area of CVD.

Consistent with several earlier systematic reviews and meta-analyses, De Souza et al. (2015) reported that consumption of TFA is associated with relative increases of all-cause mortality (34%), CVD mortality (28%) and CVD risk (21%). Additionally, every 2% increase in caloric intake from TFAs is associated with a 25% increased risk of CVD and 31% increase in CVD mortality (Mozaffarian et al., 2009; Brouwer et al., 2013). There is also reliable evidence suggesting a possible link between TFA consumption and various CVD precursors, including abdominal obesity, visceral adiposity, weight gain, metabolic syndrome and diabetes mellitus (Mozaffarian et al., 2006; Field et al., 2007; Teegala et al., 2009; Smit et al., 2010). Furthermore, animal studies have clearly demonstrated the adverse effects of TFA consumption on glucose–insulin homeostasis (Kavanagh et al., 2007).

TFA consumption increases the risk of coronary heart disease (CHD) by increasing the adverse effects on serum lipids and lipoproteins (Ascherio et al., 1999; Mauger et al., 2003; Mensink et al., 2003; Mozaffarian et al., 2006); inflammatory processes (Han et al., 2003; Baer et al., 2004; Mozaffarian et al., 2004a and 2004b); and endothelial function (Kummerow et al., 1999; de Roos et al., 2001; Baer et al., 2004; Lopez-Garcia et al., 2005). TFA intake causes a deterioration in the lipid profile by elevating the atherogenic components – namely, low-density lipoprotein (LDL) cholesterol, apolipoprotein B100 (apoB100) and triglyceride levels; and by lowering the antiatherogenic components – namely, high-density lipoprotein (HDL) and apolipoprotein A1 (apoA1) levels. In addition, TFA consumption decreases the size of LDL particles, thus leading to the formation of atherogenic small-dense LDL particles (Mauger et al., 2003; Mozaffarian & Clarke, 2009).

Beyond its hazardous effects on lipid parameters, TFA consumption is associated with inflammation and endothelial dysfunction. One dietary interventional study demonstrated that a TFA-rich diet resulted in elevated levels of E-selectin, which is a circulating marker of endothelial dysfunction (Baer et al., 2004). This result is consistent with the findings of observational studies demonstrating an association between TFA and increased levels of E-selectin and soluble cell adhesion molecules (Lopez-Garcia et al., 2005). In addition to increments in these proinflammatory molecules, TFA may also negatively affect functional measures of endothelial health such as flow-mediated dilation of the brachial artery (de Roos et al., 2001). On these grounds, it can be postulated that TFA consumption might adversely affect endothelial health (Micha & Mozaffarian, 2009).

With a weaker level of evidence compared to the relationship with CVD, observational studies suggest that TFA intake is associated with the development of stroke, sudden cardiac death, Alzheimer's disease, impaired fertility, endometriosis and cholelithiasis (Mozaffarian et al., 2006 and 2009; Field et al., 2007; Smit et al., 2010). TFA consumption may also correlate with certain malignancies, such as colon and breast cancer (Chajes et al., 2008; Vinikoor et al., 2010). However, the World Cancer Research Fund panel reported that there was insufficient evidence to state the cancer-specific position of TFA consumption (Wiseman, 2012). More studies are also necessary to evaluate the effects of TFA consumption on noncardiac mortality.

Recent studies have also investigated the efficacy of TFA elimination in the reduction of CVD mortality rates. Reduction in TFA consumption is associated with meaningful clinical outcomes. TFA content was first banned in Denmark in 2004, and reports following implementation of the policy have demonstrated that the subsequent decline in CVD mortality rates has been greater in Denmark than in other Organisation for Economic Co-operation and Development (OECD) countries (Restrepo & Rieger, 2016a). In the United States of America, Restrepo & Rieger (2016b) reported that regulations restricting TFAs were followed by a 4.5% reduction in CVD mortality between 2010 and 2013. The decline in CVD mortality rates could be interpreted as 13 fewer CVD deaths per 100 000 persons per year after the implementation of these legislative measures. Supporting the results of Restrepo & Rieger (2016b), Brandt et al. (2017) reported that members of the New York population under TFA restrictions had experienced fewer CVD events, beyond temporal trends, compared with those without restrictions. Maintenance of the expected reduction in CVD mortality with TFA elimination programmes strengthens the causal association of TFA with CVD mortality.

In summary, TFAs seem to have distinctive cardiometabolic effects on lipid metabolism causing the atherogenic side, activation of proinflammatory processes, promotion of endothelial dysfunction, and possible increased visceral adiposity and insulin resistance. All of these bring consequences that are negative for health, especially CVDs and cardiometabolic risk factors.

Consequences of the problem in Turkey

As a densely populated country with an estimated population of 83 million people, Turkey has been struggling with a large and growing burden of NCDs. NCDs not only account for 89% of all-cause deaths in the country but also for one third of premature deaths, which is itself a matter of great concern (WHO, 2018b). According to data from the Turkish Statistical Institute (TUIK), CVD ranks first among NCDs, accounting for approximately 40% of total mortality in the country over two decades (TUIK, 2019a). In 2018, the main cause of death from CVD was ischaemic heart disease (39.7%), followed by cerebrovascular disease (22.4%) (Bolluk & Özçakar, 2019). Among European countries, Turkey has the highest rate of CVD mortality in the 45–74 age group. While the Turkish population is relatively young, as in other developing societies, mortality due to coronary artery disease is as high in Turkey as in developed societies with older populations, which is a worrying sign both for today and for the future (Onat et al., 2017).

As a major threat especially to the middle-aged population, NCDs increase health expenditure and impose a significant burden on the Turkey economy. According to TUIK data, in 2018 total health expenditure amounted to 165.2 billion Turkish lira (equivalent to US\$ 35 billion at the time), which represented 4.4% of the country's gross domestic product (TUIK, 2019b).

In evaluating CVD risk factors, obesity, dyslipidemia, metabolic syndrome, hypertension, diabetes mellitus and abdominal obesity are reported to be the major determinants, and the prevalence of these factors has been increasing in Turkey over recent decades (Onat et al., 2017). For instance, data for obesity in the Turkish Epidemiology Survey of Diabetes, Obesity and Hypertension (TURDEP) I and II studies are very striking. TURDEP I, which covered 24 788 adults aged 20 years and over, found a prevalence of obesity, in 1998, of 29.9% in women and 12.9% in men (Satman et al., 2002). Twelve years later, TURDEP II showed a 40% increase in obesity in the adult Turkish population, from 22.3% in 1998 to 31.2% in 2010; by this date, the prevalence of obesity had risen in women to 44% (an increase of 34%) and in men to 27% (a 107% increase) (Satman et al., 2013). Furthermore, obesity is becoming an increasingly important public health problem for the childhood population in Turkey. The Childhood Obesity Surveillance Initiative Turkey (COSI-TUR) 2013 survey, gathering data from over 5100 children in 67 Turkish provinces, reported that 14.2% were overweight and 8.3% obese (Ministry of Health, Ministry of National Education, WHO Regional Office for Europe, 2017).

Compared to western European populations, total cholesterol levels seem to be relatively low in Turkey. Nevertheless, there are still 12 million people in the country with total cholesterol higher than 200 mg/dL. Apart from the overall levels, a poor cholesterol ratio – principally, a low level of HDL cholesterol – is known to be a significant predictor of CVD mortality. According to the

reports, the average HDL cholesterol levels in Turkish adults were approximately 20% lower in both genders than in western European societies. A 12 mg/dL decrease in HDL cholesterol is associated with an 25% increase in fatal and nonfatal coronary events. In the matter of lipid parameters, increments in the mean values of triglyceride levels were highlighted in the 17 years after 1990 (an average increase of 25 mg/dL in men and 20 mg/dL in women) (Onat et al., 2017).

Although data on the specific consequences of TFA consumption are scarce, considering the link between TFA intake and CVD and its associated risk factors, we could hypothesize that TFA intake may be one of the main predisposing factors for CVD.

Factors that influence production and consumption

There are several factors linked to the purchase and consumption of TFAs. As explained below, from the industry and supplier side, lack of technological skills and various economic factors are among the factors influencing production and consumption. From the consumers' point of view, lack of public awareness and knowledge, cultural and economic factors, and easy access to TFA-containing foods are the main factors affecting TFA consumption. From the regulatory bodies' point of view, lack of regulation, lack of monitoring and implementation, and problems related to socioeconomic status are the main factors contributing to high levels of TFA consumption. There are indications that some foods that contain partially hydrogenated vegetable oil (PHVO), which may be cheaper, are preferred by price-conscious consumers with low socioeconomic status (Downs et al., 2013).

From industry and suppliers' point of view

With a population of around 83 million, Turkey is not only a big market for the food industry; it is also a major food exporter to eastern European countries and the Commonwealth of Independent States. From fast food to packaged goods, many domestic and international food companies operate in Turkey. Snack foods, in particular, are big business, with imports adding up to more than US\$ 130 million annually. However, there is still limited information on TFA levels in food in Turkey – further research is necessary to get more reliable results and to determine the amount of TFAs in a wide variety of foods.

■ *Lack of alternative technology*

Although TFAs may be present naturally in food products derived from ruminant animals, the concentration of TFAs in dairy and meat fats is usually low (3–8%). The majority of TFAs consumed are industrially produced, and thus PHVOs are the main source of TFAs in food products. The concentration of industrial TFAs varies from 10% to 50%, depending on the production technology used (European Commission, 2019).

The bakery sector makes up 56% of the food-manufacturing industry – it is the largest part of it and has been growing in recent years (Ministry of Agriculture and Forestry, 2019). Bakery products such as cookies, crackers, cakes and bread and snacks, confectionery products, chips,

popcorn, fried foods, some margarines and spreads are the main contributors to the intake of industrially produced TFAs (Dhaka et al., 2011). In a recent study in Thailand, the fatty acid profiles of 176 food samples were analysed as potential sources of TFAs. Bakery products (such as puffs, pies and deep-fried doughnuts) that were produced with PHVOs contained 3–5% TFAs, making them the main sources of TFA in the country (Chavasit et al., 2019).

The negative perceptions associated with TFAs have led manufacturers and scientists to focus on developing alternative ways to eliminate or reduce TFAs in their products, by creating new formulations, devising modifications of fatty acid composition through hydrogenation, fractionation and interesterification (Stender et al., 1995; Karabulut et al., 2004; Kodali, 2014), and – more recently – by making use of oleogel technology (Demirkesen & Mert, 2020). These studies have shown that such technologies could be used as effective alternatives when manufacturing (for example) margarines, shortenings, confectionery and bakery products.

The main reasons for using solid fats instead of oils in food production are to achieve a lubricating effect, oxidative stability and tenderization; to improve texture and air incorporation; and to provide a solvent for some valuable nutrients, bioactive compounds and flavour carriers. This gives a delicate flavour and provides a medium for transferring heat to foods, giving a sensation of moistness in the mouth, and preventing products from going stale (Kodali, 2014; Demirkesen & Mert, 2020). In addition to the functional effects of solid fats, PHVOs, which have been industrially solidified, are cheaper alternatives to fats such as butter. In the light of these facts, from the point of view of industry, the production of food products in the absence of solid fat remains a tremendous challenge (Stender et al., 1995; Kodali, 2014; Demirkesen & Mert, 2020).

■ *Economic factors*

The Federation of Food and Drink Industry Associations of Turkey (TGDF) is the largest trade association in the country, representing 95% of the food and beverage industry. The TGDF plays a role in the collaboration between industry and government agencies, and TGDF personnel participate in meetings responsible for preparation and supervision of food standards. In addition, the Kitchen Products and Margarine Industrialists Association (MUMSAD), which covers 90% of the edible oils and fats market in Turkey, has made a voluntary commitment to reduce TFAs in its products (WHO, 2019b).

Large-scale manufacturers are more sensitized to TFA elimination in Turkey than small-scale manufacturers. While the majority of the sector publicly supports limits on TFAs, it is more difficult to tackle the issue with suppliers such as small bakery shops, fast-food markets and street-food vendors. Furthermore, it is often in these places that vegetable oils are reused in order to reduce production costs.

From consumers' point of view

■ *Cultural factors*

Consumers' food choices are influenced by many factors, including income, knowledge and education, environment, culture, lifestyle and food availability. According to the WHO Regional Office for Europe's FEEDCities project – an ongoing multicountry study describing the urban

food environments of cities in central Asia, the Caucasus and south-eastern Europe – cities and countries have street markets and other vending sites that play a unique and important part in their food culture (WHO, 2016). Pastry products such as cookies, biscuits, Turkish bagels (*simit & poğaçça*) and cakes are favoured by consumers of every age group. Pastries and similar bakery products are sold without packaging and are even distributed on the street; and as well as being culturally popular, they offer a wide variety of food choices for people on lower incomes. Fast food has also become popular in Turkey, as it is easy to prepare and fits in with current lifestyles. These types of food products are preferred by specific populations, including adolescent males, university students, and customers of ethnic-food and fast-food outlets (WHO, 2015).

■ *Lack of knowledge of food including TFAs*

TFA consumption is high in many countries, including low- and middle-income countries, where use of PHVOs can be high. High consumer awareness of the effects of TFAs on human health is the most important factor in the success of TFA regulations in high-income countries. Conversely, in middle- and low-income countries, dealing with low consumer awareness is an important issue in successfully introducing TFA regulations. If there is a high level of consumer awareness, people demand low-TFA products, and this encourages reforms in industry's production processes (Downs et al., 2013).

There are a number of criteria to which individuals pay attention when buying food and beverages, including price, trust in the brand, brand recognition, trust in the place of purchase, nutritional value, health nutrition declaration, expiry date, packaging errors, images (etc.) on the packaging, and promotional items. In Turkey, when individuals buy packaged food products, 13.7% pay attention to ingredients information on the packaging, 8.7% to images, and 7.6% to health/nutrition declarations (Ministry of Health/Hacettepe University, 2014). A study conducted by Besler et al. (2012) revealed that consumer expectations of the content of food labels are quite low and hence that the public's level of awareness needs to be increased.

■ *Socioeconomic status*

There is a two-way relationship between socioeconomic status and most health risk factors. More disadvantaged groups have higher risk factors; cost, access and knowledge are influenced by socioeconomic inequalities (McGill et al., 2015). Socioeconomic differences affect consumers' behaviour and choices as well as the quality of the food they eat and their food intake levels. Socioeconomic circumstances, determining a range of economic factors and attitudes and beliefs about food and health, affect individuals' nutrition and food choices in various ways. When the relationship between socioeconomic status and diet and nutritional status is investigated, it is reported that individuals with low socioeconomic status are more prone to diet and health inequalities (Buyuktuncer et al., 2010). Lower socioeconomic status is associated with higher intake of poor-quality foods, which have a high content of saturated fat and sugar; and with lower intake of healthier foods, such as fruits, vegetables and wholegrains (Nelson et al., 2007; McGill et al., 2015).

Lower socioeconomic status constitutes a serious risk factor for poor health because it has a determinative impact on poor nutritional health, CVD risk factors and mortality rates (Travers, 1996). The higher cost of healthier foods is a critical concern for lower income groups

because their food purchase decisions are determined by budgetary constraints: they may have difficulty substituting (for instance) a margarine with high industrial TFAs with a healthier alternative because of the extra cost involved (Ricciuto et al., 2005).

A case study from Australia on the relationship between socioeconomic position and food purchasing behaviour showed that socioeconomic indicators were significantly related to food purchasing choice. The study indicated that household income as a socioeconomic measure was the most effective discriminator for food purchasing behaviour (Turrell et al., 2002). Another study from Australia revealed that TFA intake varied according to education and income level. Those with higher education and higher incomes had lower levels of TFA consumption. For example, the TFA consumption of those with a bachelor's degree or higher was about 10% lower than that of people with lower educational attainment (Wu et al., 2017).

■ *Lack of awareness of TFAs and their negative effects*

There are several social and environmental factors linked to the consumption of TFAs in food. One is the greater ease of access to products with high industrial TFAs; another is the limited awareness of the negative health effects of TFAs (Nelson et al., 2007; McGill et al., 2015).

In order to decrease the level of TFA consumption, nutritional literacy and popular awareness of the health effects of TFAs should be increased. Availability of information on the negative health effects of consuming foods with TFAs would potentially increase health literacy among the population. In this regard, nutrition education programmes are highly recommended to increase consumer awareness and to reduce a number of health problems, especially for those with a lower level of educational attainment.

For example, a case study from Brazil indicated that most Brazilian consumers (63.5%) had at least some understanding of information to help assess the possible negative effects of TFA intake on human health. However, a significant proportion of consumers (36.5%) had no information on the health effects of TFAs (Beninca et al., 2009).

Another case study, from Saudi Arabia, focused on consumer awareness and consumption of TFAs. This study found that there was a highly negative correlation between participants' income and their awareness about hydrogenated oil. The majority of respondents did not have information on the negative effects of TFAs and did not look at food labels (Kamel & Al Otaibi, 2018).

■ *Ease of access*

Availability and affordability are among the key determinants of consumer behaviour. Consumers of lower income status generally tend to purchase products with high industrial TFAs because they are more affordable and more readily available than healthier alternatives. Making healthy food options more available and more accessible is therefore an important factor in decreasing TFA consumption. The price of foods that contain high levels of industrial TFAs should be increased through taxation in order to steer consumers' choices toward healthier products.

Some studies have suggested that a small but significant decrease in the sale of foods of minimal nutritional value occurred after a regulation was introduced that limited access to vending machines and controlled the portion size of sweetened drinks and snacks. The authors proposed that access to vending machines and snack bars should be limited in order to reduce availability and accessibility of unhealthy food options and to restrict sales of sugar-sweetened beverages (SSBs) (Jaime & Lock, 2009; Levy et al., 2011).

From regulatory bodies' point of view

According to the Turkish Food Codex Regulation on Labelling Food and Information to Consumers, if spreadable fats/margarines, dense fats, vegetable fats or foods including these fats contain more than 2% TFA, the amount of TFA should be reported on the label. In addition, if the product contains less than 1% TFA, the statement “does not contain trans-fat” can be used (voluntarily) on the product label (Official Gazette, 2017a). By contrast, some other government agencies consider that there should be a mandatory declaration on the nutritional label stating that a food item contains 0 g/less than 0.5 g TFA per serving (Food and Drug Administration, 2013). In light of this, the Turkish Ministry of Agriculture and Forestry recently introduced stricter rules in the Turkish Food Codex Regulation on the Addition of Vitamins and Minerals and of Certain Other Substances to Foods, confirming that the amount of TFA in products – the content of TFA other than TFA naturally occurring in fat of animal origin – in food intended for the final consumer and food intended for supply to retail should not exceed 2 g per 100 g of fat (Official Gazette, 2020).

Because of the functional roles that solid fat plays in food items, industry representatives share concerns about the changes in the composition of their products and the loss of sales that may follow (WHO, 2015). Although manufacturers and researchers around the world are working to create solutions and to find alternatives that allow product reformulation, in the event that laws were introduced that required TFA in food products to be limited, companies would face increased costs related to changing their current formulations and industry practices, thereby undermining sales of their familiar products (WHO, 2015). For this reason, there is a need for strategies to be developed that reduce national TFA consumption on the basis of voluntary collaboration between industry and government agencies.

■ Regulation of the informal sector

Mandatory labelling that legally requires TFA content to be stated does not apply to foods presented without packaging. Thus, even though mandatory labelling introduces a legal limit on TFA content (2%), such a limit has no direct effect on unpackaged or restaurant food. Pastry and fast-food products make up the greater part of the diet of people in Turkey, so a large number of popular food items may still contain high levels of TFA and be widely available to the public. For this reason, there should be a legal requirement that TFA content is displayed on unpackaged and restaurant food menus, and in the interests of public health, authorities should enact regulations directed at food-service establishments such as pastry shops and restaurants. The informal sector also presents a high risk especially for people with low income who may be less knowledgeable about nutrition and the health risks associated with TFA intake (WHO, 2015). The study by Downs et al. (2017) indicated that low- and middle-income countries may require

additional incentives and interventions alongside mandatory limits in order to decrease the TFA content in all foods in the food supply, including those manufactured by the informal sector.

■ *Costs related to monitoring and evaluation of policies*

Introducing a legal limit on TFAs also requires that regulations are enforced. The fact that stricter enforcement would add to the costs associated with monitoring and evaluation (including costs related to product analyses and auditing) is a significant point that should be considered during policy-making (WHO, 2015). It has been suggested that, in order to boost the impact of TFA policies, it will be necessary to continue monitoring to ensure that progress in reducing TFA content in the food supply is made over time (Downs et al., 2017).

Equity-related observations about the problem

Reducing or even eliminating consumption of TFAs will positively affect the health status of the population. There is clear evidence that TFA consumption increases the risk factors, incidence and mortality of CVDs and components of diabetes and metabolic syndrome (Monge-Rojas et al., 2017). In general, products high in industrially produced TFAs are more likely to be consumed by people of lower socioeconomic status, and the policy approaches that are devised may not deliver for these people because of their sensitivity to price differentials. Furthermore, consumers with lower understanding of labelling may continue to purchase products with high amounts of TFA.

It has been found that policies aimed at reducing TFAs in the food supply are effective and would likely reduce the burden of diet-related disease, particularly among the most vulnerable socioeconomic groups (Downs et al., 2017). Thus, the higher consumption of TFAs by people of lower socioeconomic status is a potential area for further targeting with appropriate policy action.

Therefore, policies that contribute either to reducing or to eliminating the TFA content in food may improve the quality of diet especially of people who have lower socioeconomic status, while at the same time reducing health inequality. Furthermore, increasing health literacy, public education and extensive media coverage around the country may also be required to create public awareness and to prevent the inequalities suffered by these people from becoming worse (WHO, 2015).

SELECTED OPTIONS FOR ADDRESSING THE PROBLEM

There are different policy options and interventions for targeting different groups in order to decrease the consumption of TFAs. They can be categorized under two headings, as upstream or downstream interventions. Downstream (agentic) interventions are generally based on individuals and involve behavioural perspectives; upstream (structural) interventions target an entire population and include regulatory perspectives on price, promotion, provision, composition, labelling, supply chain, trade, taxation, investment, legislation, and mandatory reformulation of food products (Hyseni et al., 2016 and 2017).

The different possible factors associated with the consumption of TFAs in Turkey, as detailed in the previous section and depicted in the problem tree in Annex 1, call for policy interventions at different levels. Although many measures could have been selected to address the problem, based on stakeholder discussions, the literature review and consideration of the main issues in the problem tree, the following three options were selected:

- (1) Establishing mandatory limits on TFAs
- (2) Labelling TFA-free foods and raising awareness of the health effects associated with TFAs
- (3) Introducing incentives to replace industrially produced TFAs with healthier oils and fats.

These options were chosen for thorough analysis as part of the evidence brief for policy (EBP) process (Box 1). Box 2 shows the methodology applied to data collection.

Box 2: Collecting evidence for options to address the problem of reducing TFA consumption

Evidence relating to three options to address the problem of reducing TFA consumption was searched for primarily from five databases: PDQ-Evidence, Health Systems Evidence, Health Evidence, the Cochrane Library and PubMed. In this way, systematic reviews were identified and collected using subject-related keywords in the title or abstract. The keywords used were “artificial trans-fatty acids”, “awareness”, “ban”, “elimination”, “food control”, “industrial trans-fat”, “intervention”, “labelling”, “nutrition labelling”, “menu labelling”, “replacement”, “reformulation” “trans-fats” and “trans-fatty acid”.

The key findings were drawn from each systematic review identified in the search process, and each was also assessed in terms of quality (Health Evidence score or AMSTAR* rating), local applicability (proportion of studies conducted in Europe), equity aspects (proportion of studies explicitly on prioritized groups), and degree of focus on the issue. The overall evidence for the three options was later summarized and relevant interpretations of the key findings of each review were introduced based on the assessments of quality, local applicability, equity aspects and degree of focus on the issue.

A total of 57 systematic reviews were identified. Some of these did not specifically address industrial TFAs and were excluded at the outset; others that were classified as “weak” in Health Evidence or given an AMSTAR score of 4 or less were also deemed unacceptable. Following this process of exclusion, after their titles and abstracts had been read and their content analysed, 22 systematic reviews were included in the EBP.

*AMSTAR (A MeaSurement Tool to Assess systematic Reviews) is a comprehensive critical appraisal instrument developed to evaluate systematic reviews.

The tables presented in Annexes 2 and 3 give details of the systematic reviews identified for each option.

Annex 2 lists the systematic reviews found in the search process that were selected for each option. The first column indicates the option or options to which each systematic review is relevant; the title of the review is given in the second column; the quality/reliability of the review is indicated in the third column, by means of a rating; and whether the review was included in the EBP is indicated in the fourth column. The rating is based on the AMSTAR and Health Evidence systems: AMSTAR assesses the overall reliability of the review, giving a grade on a scale from 0 to 11, where 11 represents a review of the highest reliability; the Health Evidence rating grades a review’s quality/reliability as weak, moderate or high on a scale from 0 to 10.

In Annex 3, the title of each selected systematic review is listed in the first column; the broad focus of the review is given in the second column; the option(s) to which each review is relevant and its main findings are given in the third column; the fourth column indicates the AMSTAR or Health Evidence rating; and the last column indicates the review’s local applicability, by stating the proportion of the studies included in the review that were conducted in Europe.

Option 1. Establishing mandatory limits on TFAs

Overview and context

Imposing regulatory limits on TFAs is one of the available government-level interventions in public health (Downs et al., 2013 and 2017). Although TFAs exist naturally at low levels in many food items, including meat and dairy products, the level of artificial TFAs can be reduced by mandatory limits. The recommended limit for consumption of TFAs should be less than 1–2% of total dietary energy (Hendry et al., 2015).

Option 1 is based on imposing mandatory maximum upper limits on TFAs in foods in order to efficiently reduce the health risk associated with TFAs. Such regulations involve setting maximum upper limits on the finished product and/or banning the use of artificial TFAs during food manufacture. This option is targeted at the population level.

It is important to consider this option alongside legislation recently introduced in Turkey which requires that fat in food intended for the final consumer and food intended for supply

to retail shall not exceed 2 g per 100 g of fat (Official Gazette, 2020). The present document was prepared before this legal regulation was put into effect and laid the groundwork for it.

Evidence of impact

We found six systematic reviews, five of medium quality and one of high quality, that covered policies introduced to decrease TFA levels in the food supply (Downs et al., 2013 and 2017; Hendry et al., 2015; McGill et al., 2015; Hyseni et al., 2016 and 2017). Five of the reviews focused on mandatory regulations and voluntary actions, including labelling, public awareness and reformulation to reduce TFA intake from foods. One of the reviews (Hendry et al., 2015) addressed the establishment of mandatory limits on TFAs specifically and looked at government regulation and legislation to influence healthy diet. Establishment of mandatory limits on TFAs was implemented in three cases – Denmark, New York City and British Columbia; in all three, obligations were imposed on the food industry to stay below maximum TFA levels in their food products.

Maximum level limits or mandatory regulation to limit use of industrial TFAs were found to be more effective in reducing TFAs in food than voluntary ones and appear to encourage food producers to reformulate their products (Hyseni et al., 2016 and 2017; Downs et al., 2017). Some WHO Member States also emphasized that they preferred a mandatory approach to reducing TFAs rather than a voluntary one. Mandatory regulation is an efficient way to decrease the health risks associated with TFA intake from foods. However, it also requires good compliance from different stakeholders, including the agriculture sector, the food industry, policy-makers, legislative and other relevant commissions, and the media (Downs et al., 2013 and 2017; Hyseni et al., 2016 and 2017).

All six systematic reviews of the policies introduced to decrease TFA levels in the food supply showed that all measures have influenced the consumption of TFAs because they are reasonable, suitable and achievable, and they are likely to have an effect on public health (Downs et al., 2013 and 2017; Hendry et al., 2015; McGill et al., 2015; Hyseni et al., 2016 and 2017). Five of the six systematic reviews (all except McGill et al., 2015) pointed out that mandatory regulations to decrease TFA levels in the food supply are more effective than other interventions; while the success of voluntary agreements depends on the extent to which different types of industry and product participate in the arrangement, mandatory limits were reported to be the most effective policy intervention to reduce TFA intake from foods.

Downs et al. (2013) gives an example from New York City, where voluntary regulation was initially preferred to decrease TFA levels in restaurant food. However, as restaurants used PHVOs as frying fats, a complete ban on TFA usage in restaurants was introduced.

Another systematic review (Hendry et al., 2015) found that the availability of industrial TFAs in food items for sale or reported on food labels had been reduced since 2004 as a result of mandatory regulations. The suggestion made by the review authors was that governments had the capacity to decrease the average population consumption of artificial TFAs because the availability of TFAs in the food supply was reduced by the specific legislation.

Restrepo & Rieger (2016b) explained how several New York State jurisdictions had embarked on restricting use of TFAs in restaurant food. The local limits on TFAs in foods included all food

services and restaurants, and usage, storage and serving of foods that had a total of 0.5 g or more TFA per serving were forbidden. TFA restrictions on restaurants were regulated by both local and state jurisdictions, and these regulations were based on the zero-gram criterion. However, their legal power remained local in force and lack of federal action meant that TFAs from industrial sources might not be fully eliminated. Restrepo & Rieger (2016b) also found that imposing an upper limit of 0.5 g per serving on TFAs in all food-service establishments in the USA led to a 4.5% reduction in CVD mortality, or 13 fewer CVD deaths per 100 000 persons annually, between 2010 and 2013.

Hendry et al. (2015), reviewing studies of the effects of mandatory limits on TFAs, noted that British Columbia had limited the use of industrial TFAs to 2% of total fat content for margarines and 5% of total fat for all other foods sold in food-service establishments. The result was 90% post-regulation compliance, according to 30 000 inspections by independent environmental health officers.

The key findings of the systematic reviews relevant to Option 1 are presented in Table 1.

TABLE 1. Summary of key findings from systematic reviews relevant to OPTION 1 (Establishing mandatory limits on TFAs)

Category of finding	Key findings
Benefits	Mandatory regulations have been rated as the most effective of the various policy options available for reducing TFAs in foods (Downs et al., 2013 and 2017; Hendry et al., 2015; Hyseni et al., 2016 and 2017). Four of the five studies of medium quality and the one study of high quality supported implementation of mandatory regulations to decrease TFA levels in the food supply (Downs et al., 2013 and 2017; Hendry et al., 2015; Hyseni et al., 2016 and 2017).
	Mandatory regulation has been rated as a basic and efficient way of decreasing intake of TFAs from foods and thus eliminating the health risks to consumers. Stronger policies (limits or bans) seem to have a greater effect than other interventions in decreasing TFA intake from the food supply (Downs et al., 2013 and 2017; Hendry et al., 2015; Hyseni et al., 2016 and 2017). Hyseni et al. (2017) indicated that TFA intake in Denmark decreased from 4.5 g/day in 1976 to 1.5 g/day in 1995; and TFAs were virtually eliminated from food in 2005 after a national ban. Hendry et al. (2015) noted that the level of industrial TFAs in Danish popcorn declined from 30 g to less than 1 g per 100 g serving after the regulation was introduced.
	Mandatory reformulation to eliminate TFAs was highly effective in Denmark, reducing consumption far more than voluntary reformulation. This is in line with a modelling study comparing voluntary and mandatory salt reformulation policies (Downs et al., 2013 and 2017; Hendry et al., 2015; Hyseni et al., 2016 and 2017). A case study showed that in Canada a TFA intake of 8.4% in the mid-1990s had dropped significantly to 4.9 g/day by 2004 and had declined further to 3.4 g/day by 2008. Overall, there was a 30% decrease in TFA intake between 2004 and 2008 (Hyseni et al., 2016 and 2017).
	TFA bans in New York restaurants caused a 4.5% reduction in CVD mortality between 2010 and 2013 (Restrepo & Rieger, 2016b; Hyseni et al., 2017).

Table 1. (Contd)

Category of finding	Key findings
Potential harms	Mandatory bans or limits may increase the use of alternatives to TFAs. Some of these, including palm oil, are consistently cheaper and easier to use in products, as well as ensuring a longer shelf-life. However, they contain high levels of saturated fatty acids (Downs et al., 2013).
Resource use, costs and/or cost-effectiveness	TFA bans would reduce heart disease risk, bring most benefit to socioeconomically disadvantaged populations, and be cost-saving (Downs et al., 2017).
Uncertainty over potential benefits and harms (so monitoring and evaluation could be warranted if the option were pursued)	<p>The studies within these systematic reviews were not directly comparable, because there were important differences between countries and their implementations as well as their outcomes. For instance, the context and content of local and national TFA bans were different from each other; while the national ban in Denmark was based on total elimination of TFAs from the food supply, a fast-food meal containing 5 g of TFA could be sold in New York City despite the local TFA ban (Downs et al., 2013).</p> <p>Most of the studies included in these systematic reviews were from high-income countries; a few included examples and implementations from low- and middle-income countries but only with limited data (Downs et al., 2013 and 2017). The need for further research on low- and middle-income regions, to analyse country-specific challenges and possible solutions, was underlined (Downs et al., 2013 and 2017).</p>
Key elements of the policy option if it was tried elsewhere	<p>The success of mandatory regulations requires both political awareness and commitment. It is known that bans are the most effective policy intervention, but the political will to prepare the legislation is not always available in many countries and states. Resistance could come from both food and agriculture industries, as well as from other sectors in the government and individuals. For instance, the local government in the city of Cleveland put into law a ban on TFAs in food, but it was later blocked by the Ohio state government (Downs et al., 2013).</p> <p>Legislation to ban industrial TFAs from the food supply requires the involvement of many stakeholders, including the agriculture sector, the food industry, key policy-makers including politicians and bureaucrats, legal commissions, councils and media campaigns to promote acceptance by the public (Downs et al., 2013 and 2017; Hyseni et al., 2016 and 2017).</p>
Stakeholders' views and experiences	<p>The food industry has tended to oppose implementation of mandatory bans, limitations and restrictions aimed at reducing TFA levels in the food supply because they fear reduced profits or additional costs involved in reformulating products (Downs et al., 2013 and 2017; Hyseni et al., 2016 and 2017).</p> <p>Some WHO Member States emphasized that they preferred a mandatory approach to reducing TFAs rather than a voluntary one.</p>

Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs

Overview and context

■ *Labelling TFA-free foods*

Nutritional labels provide consumers with information about the content of a food or drink. The type of information provided varies depending on the content of the food, such as fat, sugar, salt or energy content. The information also varies in the way it is presented – for example, as a single number, as a proportion as a guide to daily consumption, or by means of colours indicating relative health (Crockett et al., 2018). Nutritional label schemes are generally designed to guide consumer selection and sometimes include an interpretive component such as colour-coding relating to a daily intake guide or indicating relative health status.

Food labelling is applied in many ways in different countries. In this context, the United States, the United Kingdom, Sweden, Norway, Denmark, Australia, Brazil, New Zealand and Canada are the main countries where food labelling is applied; in some countries implementation is voluntary, in others it is mandatory (Swartz et al., 2011; Downs et al., 2013; Sinclair et al., 2014; Cecchini & Warin, 2016; Fernandes et al., 2016; Hyseni et al., 2017; Crockett et al., 2018; Kliemann et al., 2018; von Philipsborn et al., 2019; Shangquan et al., 2019).

Nutrition labelling is a policy tool that can support healthy nutrition by encouraging consumers to be conscious about choosing healthier foods and by encouraging manufacturers to reshape their products to accurately explain their nutrient content (Kelly & Jewell, 2019). Food labelling gives information about a food, details, trademarks and brand name and may include pictorial items or symbols. At the same time, any packaging, document, declaration or label accompanying or referring to such foods should be easily visible and provide useful information to consumers about nutritional value and food safety, including identification of substances that may cause allergic reactions (Marcotrigiano et al., 2018).

There is a growing need for labelling of food products that facilitates proper nutrition. Diseases that threaten public health, such as obesity, have reached very high levels in recent years in both industrialized and developing countries. Governments and consumer groups are seeking ways to improve the nutritional choices available to their citizens, as well as to balance freedom of choice using nutritional labels (Kasapila & Shaarani, 2016). The information contained in food labels has been recognized as a means of encouraging consumers to make healthier choices when shopping for food. This process is not simply a matter of providing information to consumers, because buying is often linked to ingrained habits and buying decisions may be made relatively quickly. Various competitive priorities also need to be considered. Current evidence shows that about 25% of United Kingdom consumers use nutrition labels and that information is used mostly by women, parents, people with more education and higher-income groups (Buttriss, 2018).

As food today is increasingly consumed outside the home, the availability of energy information in menus and on menu boards (for example, menu energy labelling) at restaurants and food outlets has become an increasingly valuable tool to allow consumers to make healthier choices at these outlets (Sarink et al., 2016). In practice, the concept of menu labelling is used with different meanings. Some authors use labelling as a synonym for the introduction of calories information, while others use labelling to identify information such as calories and nutrients contained in food or as a reference to the traffic-light system or other food information (Fernandes et al., 2016). While it is agreed that the effect of nutritional labels is influenced by consumer characteristics, there are different views on their impact, as some types of label are more effective than others. A recent study shows that, although standard calorie-level labelling on food products does not directly affect calorie selection or consumption, both outcomes are reduced when the labelling contains contextual information such as traffic-light symbols (Christoph & An, 2018).

Hyseni et al. (2016) also evaluated the relationship between labelling and reformulation policies. It has been reported that food labelling may put pressure on manufacturers to use reformulation strategies while presenting opportunities to consumers to choose and purchase healthier options.

I Raising awareness of the health effects associated with TFAs

Raising awareness of the negative health impacts of TFA consumption, the definition of TFAs and the amount of exposure to TFAs plays a central role in implementing all strategies targeted at elimination of TFAs, including policy changes and industry actions. Actions focused on increasing awareness should aim to enhance understanding of the goal of eliminating TFAs, and these actions should target national governments including policy-makers, food control and safety authorities, civil society organizations, the food industry, and (especially) consumers. Dividing awareness actions into specific categories to suit these different constituencies is difficult because they tend to be interlinked (Downs et al., 2013; Mozaffarian et al., 2012).

Increasing awareness is critical to the task of changing consumer behaviour, particularly if it is enhanced by more upstream interventions including policies on TFA elimination (Hawkes, 2013; Capacci et al., 2012). TFA reduction has been achieved in several high-income countries through a combination of public awareness campaigns with mandatory labelling, reformulation of products and TFA bans (Leth et al., 2006; Perez-Ferrer et al., 2010). It has been suggested that key factors that have led to the success of TFA regulations are high consumer and political awareness of the negative health impacts of TFA consumption (Perez-Ferrer et al., 2010). Furthermore, the success of awareness-raising interventions leads to sustained consumer demand for lower levels of TFAs in products, so ensuring industry actions on TFA elimination and continued product reformulation by industry. In simple terms, creating awareness is needed in order to sustain other interventions.

The major step in raising awareness of health issues is nutrition education with the main goal of changing behaviour. Nutrition education activities should extend beyond a process of merely providing information and should encompass motivational information and communication strategies, provision of cooking skills, and changes in the food environment (Schuster, 2011;

Ashton et al., 2019). Based on a systematic review, Contento et al. (2007) reported that nutrition education actions are more likely to yield positive results when a broader definition of nutrition education is applied – that is, when actions are implemented as part of large, multicomponent interventions and are not seen as information provision or direct education alone. It is noteworthy that a growing number of actions taken by governments have involved multiple components, such as combining policies on nutrition labels with education campaigns, public awareness campaigns with food product reformulation, and school food standards with educational initiatives in schools (Hawkes, 2013). Schools seem to be one of the most suitable arenas for applying nutritional interventions. It was found that multi-strategy health interventions, including theoretically based nutrition education facilitated by school staff (as well as families) in conjunction with changes to healthier school food environments, had a significant impact on the nutrition of adolescents (Meiklejohn et al., 2016).

Nutrition education strategies include, specifically, public awareness campaigns, education in specific settings, skills training and changes in the food environment. Public awareness campaigns are organized communication activities that aim to create awareness and change behaviour in the general population (Hawkes, 2013). They are often characterized as mass media campaigns. In terms of raising awareness, the role and importance of the media in facilitating change cannot be overlooked. Active interest by the media in increasing consumer awareness and putting pressure on industry to meet the challenges associated with reducing TFA content in foods was a central aspect of TFA reduction activities in Denmark, Canada, New York City and Argentina (L'Abbé et al., 2009). WHO (2011) recommends mass media campaigns as one of their “Best Buys” for NCD prevention and control. Such campaigns involve providing information to the general public through a variety of channels, including health and education-related settings, public relations events such as talks, demonstrations and tours, social media and mass media. The Danish Nutrition Council announced that major sources of industrially produced TFAs in Denmark included margarine, packaged snack products, bakery products and confectionery items. These findings attracted significant media attention around the dangers of industrially produced TFAs in Denmark, leading to popular support for limiting TFAs. Furthermore, social media have been growing increasingly popular; trials assessing the effectiveness of social media interventions in modifying NCD risk factors show that social media use does improve primary outcomes, increasing awareness and decreasing consumption of TFAs (Meiklejohn et al., 2016; Mita et al., 2016).

One example of success is the Food Safety and Standards Authority of India (FSSAI), which launched a mass media campaign in November 2018 calling for elimination of industrially produced TFAs in the food supply. A 30-second public service announcement supported the FSSAI's target of eliminating industrially produced TFAs in fats and oils by 2022, a year ahead of WHO's global target for eliminating them. The public service announcement was launched at a press release, where it garnered substantial media coverage spanning broadcast, print and online outlets, and it was broadcast in 17 languages for four weeks on major digital platforms such as YouTube, Facebook, Hotstar and Voot. In December 2018, following the campaign launch, the Ministry of Health and Family Welfare approved the release of a draft regulation that lowered the existing TFA limit (5% of total fats) to 2% in fats and oils (WHO, 2019b).

Nutrition education actions take place in various settings, including places where food is produced, sold (including retailers, food service outlets, and public sector catering outlets in schools, workplaces, etc.), and consumed (for example, households), and where information and education on food and diet are provided (such as health service settings). One example of TFA education actions is the initiative of New York City Department of Health and Mental Hygiene, which prepared several informative materials to assist restaurants in reformulating their products to comply with the new regulations ([New York City Department of Health and Mental Hygiene, 2016](#)). One part of the initiative was a Trans-Fats Help Centre which was set up to assist food service establishments by providing them with information on how to replace TFAs, including products and prices for TFA-free frying oils, margarines and shortenings. In addition, a variety of informative materials was prepared on topics such as how to choose and use healthier oils, what to look for in mixes and ready-made items, questions and answers, etc. Recognizing that restaurants are often multiethnic in nature, information was made available in a variety of languages, including English, Spanish, Arabic, Bengali, Chinese, Korean and Russian.

In some countries, where awareness of TFAs is low, a reformulation strategy has not been adopted by the food industry. In Brazil, TFA levels in some margarines remained at over 50% post regulation, which may be related to a low level of consumer awareness ([Downs et al., 2013](#)). Variations in different ethnic and socioeconomic subgroups are also often related to increased intake of foods high in saturated fat and sugar, poor nutrition and poorer health ([Hyseni et al., 2016](#)).

Evidence of impact

■ *Labelling of TFA-free foods*

We found 14 systematic reviews, one of low quality (not included in the EBP), seven of medium quality and six of high quality, regarding policies introduced to decrease TFA levels in the food supply ([Downs et al., 2013](#); [Hyseni et al., 2016 and 2017](#); [Al-Khudairy et al., 2019](#); [Cecchini & Warin, 2016](#); [Christoph & An, 2018](#); [Fernandes et al., 2016](#); [Sarink et al., 2016](#); [Shangguan et al., 2019](#); [Sinclair et al., 2014](#); [Crockett et al., 2018](#); [von Philipsborn et al., 2019](#); [Kliemann et al., 2018](#); [Mozaffarian et al., 2012](#)). Four of the reviews focused on multicomponent interventions comprising legislation and voluntary actions that included labelling, awareness and reformulation of foods to reduce intake of TFAs. Five of the reviews focused on food labelling to assess its effectiveness in increasing the selection of healthier products and reducing calorie intake. Four of the reviews focused on menu labelling to assess the influence of diverse menu-labelling formats on food choices in real-life settings. Two of the reviews focused on nutrition labelling to explore possible modifiers of the effect of such labelling on purchasing and consumption.

Although significant progress has been made as a result of food labelling in countries such as Canada and the USA, TFA levels need to be further reduced, especially in margarines and bakery products. Perhaps one of the strongest arguments in favour of mandatory TFA labelling is that it leads to product reformulation. The driving force for product reformulation is often consumer pressure pushing for products low in TFAs. In the review, the success of mandatory TFA labelling was found to vary greatly depending on the food category concerned ([Downs et al., 2013](#)).

In various studies on the effects of food labelling, TFA levels were examined before and after policy interventions. In Canada, mandatory TFA labelling combined with voluntary boundaries led to a 35% reduction in TFAs in breast milk and a 30% reduction in dietary intake in the general population. In the USA, mandatory TFA labelling has been associated with a 58% reduction in TFA levels in blood plasma. In the Netherlands, voluntary self-regulation of TFA levels has been associated with a 20% reduction in dietary intake. As noted, the success of mandatory TFA labelling depended greatly on the food category involved (Downs et al., 2013), and there was mixed evidence of the effectiveness of labelling interventions. Al-Khudairy et al. (2019) reported that in two studies labelling interventions had no effect on purchasing, but that in another study purchasing behaviour was altered.

Many studies in different countries have investigated multicomponent interventions for food selection and nutritional processes, all involving food reformulation, labelling and voluntary restrictions on the TFA content of industrially produced foods. Food labelling has the potential to help consumers make more informed decisions in their food purchasing and nutrition and has the effect of putting pressure on the food industry to reformulate food. Several modelling studies on the effects of food labelling alone predicted a decrease in TFA consumption from 0.3 g to 1.2 g/day (Hyseni et al., 2017).

The potential effect of policy actions involving nutrition labelling on purchasing food or drink options in real-world settings, including purchases from vending machines, grocery stores, restaurants, cafeterias and coffee shops, was evaluated by Crockett et al. (2018). They found that energy labelling on menus in restaurants showed a statistically significant reduction of 47 kcal in energy purchased.

Downs et al. (2013) noted that mandatory TFA labelling and voluntary TFA limits had a varying degree of success, depending on food category. Changes in TFA levels in margarines and bakery products were smaller in countries without a national ban. Thus, an overview of this systematic review concluded that downstream interventions such as advice to individuals might increase the gap in socioeconomic inequalities, while population-based policy interventions may decrease inequalities. Furthermore, multicomponent interventions may be more effective than single interventions (Hyseni et al., 2016 and 2017).

■ *Raising awareness of the health effects associated with TFAs*

We found four systematic reviews, one of medium quality and three of high quality, considering policies introduced to decrease TFA levels in the food supply (Mozaffarian et al., 2012; Meiklejohn et al., 2016; Ashton et al., 2019; Mita et al., 2016). One of the reviews focused on poor lifestyle behaviours and the optimal population-level approaches to improve lifestyle. Another review focused on updated evidence on the impact of multi-strategy nutrition education interventions on adolescents' health and nutrition outcomes and behaviours. A third review focused on evaluating the effectiveness of interventions that aimed to improve dietary intake among healthy young adults. The final review focused on synthesizing evidence of the effect of social media use (compared to no social media use) as part of interventions to reduce NCD risk factors.

A review of the evidence based on all media and educational campaigns, conducted by Mozaffarian et al. (2012), concluded that there is some evidence that sustained, dedicated media and educational campaigns, using multiple channels focused on reducing consumption of specific unhealthy foods, can be effective.

The results of studies of public awareness campaigns in all their different forms are mixed. This raises the question of whether countries have enough guidance on designing campaigns for their specific populations, what complementary actions they should take to reinforce the intended change in awareness, and which foods and nutrients to focus on. This latter point reflects the finding that “eat less” campaigns have tended, to date, to be less prevalent than campaigns targeting “positive” foods and generic healthy eating (Hawkes, 2007).

Consumer education efforts were widely used after 2007 in many countries in Latin America and the Caribbean, including Guatemala, Ecuador, Mexico, Costa Rica, Chile and Mercosur countries (Argentina, Brazil, Uruguay). TFA information was included in national health education campaigns and in nutritional guidelines for the Brazilian, Chilean, Argentinian, Costa Rican and Uruguayan populations. Mexico, Brazil and Costa Rica had existing food composition tables with a wide variety of foods consumed in their national diets. In 2011 and 2012, Costa Rica and Ecuador incorporated the issue of TFAs in a national policy, and Mexico produced a proposal to reduce TFAs in foods to a minimum. Challenges to the implementation of policies to reduce TFAs that were identified included: shortage of information on TFA content in diets and foods, lack of consumer awareness of TFAs, and lack of monitoring and surveillance (Colon-Ramos et al., 2014).

In the USA, after the “Face the Fats” national consumer education campaign in April 2007, consumer awareness about TFAs increased and attained a similar level of awareness to that of SFAs. The increased awareness was associated with improved self-reported behaviours in grocery shopping. Nonetheless, overall knowledge, especially regarding food sources of SFAs and TFAs, still remained relatively low, underlining the urgent need for more extensive consumer education activities. The positive change in consumer awareness about TFAs was likely attributable to the wide range of messages consumers were exposed to, including the American Heart Association “Face the Fats” national consumer education campaign (Eckel et al., 2009).

According to Capacci et al. (2012), improved labelling and use of mass media campaigns to improve consumer awareness were deemed feasible. These strategies, in conjunction with upstream policies aimed at increasing production of healthier oils and making them more affordable, could be effective in terms of changing consumer behaviour.

A summary of the key findings of the systematic reviews relevant to Option 2 are presented in Table 2. For more information about the reviews contained in Table 2 (or to obtain citations for them), please refer to Annexes 2 and 3.

TABLE 2. Summary of key findings from systematic reviews relevant to Option 2 (Labelling TFA-free foods and raising awareness of the health effects associated with TFAs)

Category of finding	Key findings
Benefits	Labelling of TFA-free food:
	<p>Various systematic reviews have shown that labelling of food products is an effective option in reducing TFA content in food and dietary intake (Crockett et al., 2018; von Philipsborn et al., 2019; Cecchini & Warin, 2016; Fernandes et al., 2016; Hyseni et al., 2017; Shangguan et al., 2019; Sinclair et al., 2014; Kliemann et al., 2018; Swartz et al., 2011). In one review, it was found that food labelling increased the amount of healthy food products by 17.95% and also reduced calorie intake/selection by about 3.59% (Cecchini & Warin, 2016). It was also found that food labelling and individual diet counselling led to a decrease in consumption of TFAs by about 0.8 g/day (Hyseni et al., 2017). Another systematic review confirmed that a combination of mandatory labelling and voluntary limits brought about a 30% reduction in dietary TFA intake in the general population (Downs et al., 2013).</p>
	<p>Christoph & An (2018) showed that food label exposure is associated with improved nutrition and that nutrition labels positively affect dietary quality.</p>
	<p>Fernandes et al. (2016) found that menu labelling had a partial effect on food choices. It was found that menu labelling is more effective in cafeterias than restaurants, and qualitative information such as healthy food symbols and traffic-light labelling are the most effective methods to promote healthy eating.</p>
	<p>The review of intervention studies by Shangguan et al. (2019) showed that food labelling reduces consumer dietary intake of selected nutrients and influences industry practices to reduce the product content of sodium and industrial TFAs. In a meta-analysis of 60 studies, including 111 intervention branches and more than 2 million observations in 11 countries, food labelling was seen to increase vegetable consumption while reducing total energy and total fat consumption.</p>
	<p>In a review conducted in laboratories, college cafeterias and fast-food restaurants, an experimental or quasi-experimental design was used to compare a calorie-free menu with a calorie menu. Only two of the seven studies reported a statistically significant reduction in calories purchased by consumers using calorie-labelled menus. Current evidence suggests that calorie labelling does not have the intended effect of reducing calorie intake or consumption (Swartz et al., 2011).</p>
	Raising awareness of the health effects associated with TFAs:
<p>Raising awareness of the negative health effects of TFA consumption is a significant component of TFA elimination programmes. More upstream interventions, including banning TFAs in foods and mandatory labelling, have an impact on the applicability and success of the strategies (Downs et al., 2013; Mozaffarian et al., 2012).</p>	

Table 2. (Contd)

Category of finding	Key findings
Benefits (contd)	<p data-bbox="427 393 1161 423">Raising awareness of the health effects associated with TFAs (contd):</p> <p data-bbox="427 458 1344 584">A review of the evidence based on all media and educational campaigns conducted by Mozaffarian et al. (2012) concluded that there is some evidence that sustained, dedicated media and educational campaigns, using multiple channels focused on reducing consumption of specific unhealthy foods, can be effective.</p> <p data-bbox="427 619 1344 740">The major step in raising awareness of health issues is nutrition education with the main goal of changing behaviour (Schuster, 2011; Ashton et al., 2019). Nutrition education strategies include, specifically, public awareness campaigns, education in specific settings, skills training and changes in the food environment.</p> <p data-bbox="427 776 1344 897">Active media interest in increasing consumer awareness of the TFA content of foods, and pressurizing industry to meet the challenges associated with reducing it, was a central aspect of TFA reduction activities in Denmark, Canada, New York City and Argentina (L'Abbé et al., 2009).</p> <p data-bbox="427 932 1344 995">It has been suggested that social media may improve the primary outcomes in interventions (Meiklejohn et al., 2016; Mita et al., 2016).</p> <p data-bbox="427 1030 1344 1152">According to Capacci et al. (2012), improved labelling and use of mass media campaigns to improve consumer awareness were deemed feasible. These strategies, in conjunction with upstream policies aimed at increasing production of healthier oils and making them more affordable, could be effective in terms of changing consumer behaviour.</p>
Potential harms	<p data-bbox="427 1187 1344 1470">In most countries that apply mandatory food labelling, it is required that portion size be presented on food labels, but changes to this information are generally permitted. Studies in this area have reported a lack of standardization of portions sizes across similar products that could compromise the validity of nutrition information. Furthermore, research shows that food companies can promote sales by reporting low values or low energy values of certain nutrients on information labels. In order to provide clear and easy-to-understand nutrition information to the consumer, there is a need to define the best format in which to present portion sizes on food labels (Kliemann et al., 2018).</p> <p data-bbox="427 1505 1344 1720">Although use of nutrition labels is high, it is suggested that actual use of food labels during food purchase may be lower. This shows that consumers involved in research into use of nutrition labelling are open to socially requested reporting and can look at nutritional labels without fully understanding all the information provided. Reported reasons for not using nutrition labels include lack of time, the way information is presented, lack of understanding of terms, and concerns about the accuracy of information (Cowburn & Stockley, 2005).</p>

Table 2. (Contd)

Category of finding	Key findings
Resource use, costs and/or cost-effectiveness	<p>Some foods with lower TFA levels are more expensive, which is more keenly felt by consumers of low socioeconomic status. A study by Ricciuto et al. (2005) found that some margarine companies in Canada offer low-TFA products while continuing to sell products with higher levels of TFAs at lower prices. Therefore, price-conscious consumers are more likely to consume less healthy products and thus increase the risk of diet-related chronic illness (Downs et al., 2013).</p>
Uncertainty regarding benefits and potential harms (so monitoring and evaluation could be warranted if the option were pursued)	<p>In the systematic reviews examined within the scope of the present study, there was no review that considered the effects of food labelling alone. On the contrary, most studies looking at food labelling examined citizens' understanding of food labelling, label usage, food buying and purchasing behaviour, rather than measuring TFA intake (Hyseni et al., 2017).</p> <p>The results of studies of public awareness campaigns in all their different forms are mixed. This raises the question of whether countries have enough guidance on designing campaigns for their specific populations, what complementary actions they should take to reinforce the intended change in awareness, and which foods and nutrients to focus on. This latter point reflects the finding that “eat less” campaigns have tended, to date, to be less prevalent than campaigns targeting “positive” foods and generic healthy eating (Hawkes, 2007).</p>
Key elements of the policy option if it was tried elsewhere	<p>For food labelling regulation to be effective, the population must be both aware of TFAs and able to interpret nutritional labels correctly. In high-income countries with high levels of literacy, labelling is likely to be more effective in reducing TFA intake than in low- and middle-income countries (Downs et al., 2013).</p> <p>Multicomponent interventions including legislation to eliminate TFAs from food products may be more effective than single interventions (Hyseni et al., 2016 and 2017).</p> <p>Political awareness and commitment were important for the success of many of the policy interventions aimed at reducing TFAs in the food supply (Downs et al., 2013).</p> <p>There are several limitations to the implementation of labelling policies. First, TFA intake among citizens may still be high. Second, some foods with low TFA levels are more expensive, which will be felt more keenly by consumers of low socioeconomic status. Third, for labelling regulation to be effective, the population must be aware of TFAs and be able to interpret nutrition labels correctly (Downs et al., 2013).</p> <p>A review of the evidence based on all media and educational campaigns conducted by Mozaffarian et al. (2012) concluded that there is some evidence that sustained, dedicated media and educational campaigns, using multiple channels focused on reducing consumption of specific unhealthy foods, can be effective.</p>

Table 2. (Contd)

Category of finding	Key findings
Stakeholders' views and experiences	It has been reported that food labelling may put pressure on manufacturers to use reformulation strategies while presenting opportunities to consumers to choose and purchase healthier options (Hyseni et al., 2016).
	In some countries, where awareness about TFAs is low, a reformulation strategy is not applied by the food industry. In Brazil, TFA levels in some margarines remained over 50% post regulation, which might be related to a low level of consumer awareness (Downs et al., 2013).

Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats

Overview and context

The consumption of TFAs is strongly associated with increased CVD risk and related risk factors, as well as mortality (Brouwer et al., 2013; De Souza et al., 2015; Mozaffarian et al., 2009; Nishida & Uauy, 2009). A systematic review by Mozaffarian & Clarke (2009) indicated that replacement of PHVOs, which are the main source of industrial TFAs, with alternative fats and oils would substantially lower CHD risk. The benefits obtained would be greatest by replacing PHVOs with vegetable oils. It has also been shown that even replacement of PHVOs with tropical oils or animal fats would result in benefits. The food industry should therefore engage with food reformulation not only to reduce TFA content but also to raise the overall health benefit by using replacement fats and oils with a higher content of cis-unsaturated fat.

In order to eliminate TFAs in food products, finding technological solutions for product reformulation and working with the industry on the adoption of reformulation technologies is one of the critical approaches. Generally, industry members (retailers, manufacturers and food service) support strategies to eliminate TFAs from food products, but it should be highlighted that product reformulation is not easy or cheap.

Governments can provide incentives such as consumer-friendly labelling, pricing policies, taxation, financial support for research and development (R&D) projects and reformulation steps, and policies to create a new competitive market of reformulated products for manufacturers and retailers, and these incentives may be posited as potential policy instruments to reformulate food products. European Union countries have focused on incentives and disincentives to the use of sugar in manufactured foods, covering both supply and demand sides (WHO, 2017). For example, the French government has signed a voluntary agreement with various manufacturers and retailers that includes specific commitments to reduce sugar in certain products. One of

the commitments signed with a breakfast cereal manufacturer was undertaken in order to reduce sugar in their range of products by between 3.8% and 15%. Another commitment, signed with a retailer, covered a range of product categories and private-label products accessible to lower socioeconomic groups. In the Netherlands government authorities established sector-wide agreements to encourage manufacturers to reduce the sugar content of food. In Norway, the Food Industry Group was established by the Ministry of Health in order to determine the industry's responsibilities to enhance public health. To achieve this goal, the signatories to a letter signed by members of the group could choose one of several possible approaches, such as reformulating products, developing healthy new products, shifting advertising to healthier products, and increasing consumer awareness about making healthier choices in various ways including product placement, portion size, pricing, packaging, labelling and advertising. In the United Kingdom, guidelines comprising various approaches have been developed for manufacturers and retailers in the food and drink industry. The approaches were determined on the basis of product category – for example, for confectionery, a portion size reduction strategy was used, while a two-tiered tax has been introduced for sugary drinks (WHO, 2017).

In the literature, there are many studies looking at the implementation of fiscal measures to control the consumption of products such as sugar-sweetened beverages (SSBs) and fatty foods. Although many of these studies suggest that implementation of fiscal measures significantly reduce consumption of unhealthy foods, some of them have nevertheless questioned the simple association between fiscal measures and the consumption rate of unhealthy foods, and it has been highlighted that further research is needed to evaluate the effectiveness of fiscal measures on dietary changes. Powell & Chaloupka (2009) found that the effectiveness of taxes was dependent on a country's level of income. Generally, the relationship between the purchase of food and fiscal measures was found to be weak in the case of high-income countries, while in low-income countries it was found to be stronger. Thow et al. (2014) showed that fiscal policies (such as SSB taxes, fat- and calorie-based taxes, nutrient profiling-based taxes, and healthy food subsidies) were effective in promoting the desired dietary changes; of these, SSB taxes were found to be the most effective. In another systematic review, it was noted that taxation significantly affected planned purchases and raised the probability of healthy beverages being purchased (Redondo et al., 2018).

Several primary studies conducted in various countries (including the USA, Canada, New Zealand, the United Kingdom, Estonia, Denmark and India) have demonstrated that reformulation of products appears to be an effective option for reducing TFA content (Allen et al., 2015; Arcand et al., 2014; Downs et al., 2012; Hutchinson et al., 2018; Knai et al., 2017; Monge-Rojas et al., 2017; Ratnayake et al., 2009a and 2009b; Roe et al., 2013; Rippin et al., 2017; Temme et al., 2011; Thomson et al., 2016; Otite et al., 2013). Livingstone et al. (2012) reviewed reformulation in the supply chain by altering the diet of cows to investigate the effect on milk and dairy products. A double-blind randomized crossover intervention study found a 16% decrease in SFAs and an increase in MUFAs (+10%) and PUFAs (+7.5%). Similarly, a study featuring a meta-analysis of randomized controlled trials suggested that replacing 10% of dietary SFA intake with PUFAs might reduce CVD risk by 10% (Hyseni et al., 2016).

Generally, large-scale manufacturers are more sensitized to TFA elimination, while many smaller ones may not have sufficient capacity to reformulate products to eliminate TFAs. It has been highlighted that use of cost-effective alternatives in products will require extensive engagement with industry (Downs et al., 2013). The negative economic outcomes associated with industry reformulation costs have been clearly documented in various studies (Downs et al., 2013; Allen et al., 2015). Thus, one of the problems encountered with reformulation of products is the cost it represents to industry, alongside concerns that consumer (lack of) acceptance of reformulated products may affect sales (Ratnayake et al., 2009a and 2009b; Temme et al., 2011; Downs et al., 2012; Otite et al., 2013; Roe et al., 2013; Arcand et al., 2014; Allen et al., 2015; Thomson et al., 2016; Knai et al., 2017; Monge-Rojas et al., 2017; Rippin et al., 2017; Hutchinson et al., 2018).

In the food industry, the partial hydrogenation process, which may lead to formation of TFAs, is used because it gives products the functionality and stability characteristics of solid fats. One of the main challenges in product reformulation is finding suitable structuring techniques that can be used for vegetable oils and that give the resulting products qualities and properties that are acceptable to consumers (Downs et al., 2013). In order to eliminate the problems associated with use of TFAs and to maximize the health benefits of products, a solution for the food industry appears to be to substitute unsaturated fats for TFAs during reformulation. However, it has been stated that, if products are formulated with vegetable oils rich in PUFAs, problems associated with high oxidation and low melting point have to be considered. For this reason, reformulating foods with vegetable oils rich in PUFAs without considering oil stability might be questionable (Menaar et al., 2013).

Even though the food industry can formulate products without using the partial hydrogenation technique by using interesterification, fractionation and blending techniques, reformulation without using solid fats still presents a challenge in the case of certain food items such as bakery products. Consequently, researchers are still trying to find alternatives for use in product reformulation; one promising candidate is oleogels, which recent studies report have been successfully used as structured solid-like materials in bakery products (Demirkesen & Mert, 2020).

After a reformulation strategy was adopted in Canada, TFA levels in food products fell from $26 \pm 13\%$ to $2 \pm 4\%$ (Ratnayake et al., 2009a). This study also found that, although the TFA content of food products decreased, the estimated solid fat intake was generally unaffected. By contrast, another study conducted in Canada (Arcand et al., 2014) found that some cookie and cake varieties, brownies and squares, dessert toppings, and lard and shortenings, which had low amounts of TFAs after adoption of the reformulation strategy, had higher amounts of saturated fat. The authors attributed this finding to the addition of saturated fats during reformulation.

Palm oil, for example, because of its high availability and low cost, may be used for partial hydrogenation of vegetable oil in some products, but it has high saturated fat. Thus, most manufacturers were not concerned about a potential rise in saturated fat due to elevated use

of palm oil, and hence preferred not to use PUFAs in product reformulation (Downs et al., 2013). It is evident that reformulation of products using polyunsaturated, monounsaturated or saturated fatty acids is preferable, in terms of health benefits, to not reformulating at all (Demirkesen & Mert, 2020). However, it should be stressed that greater health benefits can be gained by replacing TFAs with vegetable oils that have higher amounts of unsaturated fatty acids, rather than with tropical oils such as palm oil, which are rich in SFAs (Monge-Rojas et al., 2017). A continuing rise in demand for alternative oils is expected to lead to an improvement in global supply and quality; in this way, economic problems due to the costs of industry reformulation can be lessened, in the long term, by use of reformulation techniques (Downs et al., 2013).

Evidence of impact

Seven systematic reviews were found that deal with reformulation of foods containing industrially produced TFAs and use of incentives to replace industrially produced TFAs with healthier oils and fats. On the basis of their AMSTAR ratings, we included six of the systematic reviews in this evidence brief and excluded one that was considered unreliable. We found one high-quality systematic review (Hyseni et al., 2017) and five moderate-quality systematic reviews (Downs et al., 2013 and 2017; Hyseni et al., 2016; Mozaffarian & Clarke, 2009; Clifton & Keogh, 2017) relating to reformulation of foods containing industrially produced TFAs and regulatory statements on the replacement of industrially produced TFAs with healthier oils and fats. Although incentives such as price and taxation have been shown to be potentially powerful tools for reducing consumption of tobacco, alcohol and SSBs, we did not find any study assessing the impact of incentives on TFA-containing foods (Hyseni et al., 2017).

The potential effectiveness of policy actions relating to promotion, provision, composition, labelling, supply chain, trade/investment and multicomponent interventions to improve healthy food consumption and thus prevent NCDs has been evaluated by Hyseni et al. (2016). Compared to voluntary reformulation, mandatory reformulation has been found to be more successful in eliminating industrial TFA consumption (Hyseni et al., 2016; Downs et al., 2013).

In the systematic review of Mozaffarian & Clarke (2009), three different PHVO formulations (containing 20%, 35% and 45% TFA) were replaced with other fats or oils in order to calculate the effect of reduced TFAs. It was found that the predicted CHD risk reductions were greatest when at least half the TFA in PHVOs was replaced with soybean oil or canola oil. The conclusions of this systematic review suggested that the food industry should be involved in food reformulation not only to reduce the TFA content but also to raise the overall health benefit by using replacement fats and oils with a higher content of cis-unsaturated fats. Another study assessed the influence on CVD of novel soybean oils with different fatty acid profiles (Lichtenstein et al., 2006). Varieties of soybean oils resulted in more favourable lipoprotein profiles than did the partially hydrogenated form. Thus, it was shown that soybean oils may offer a viable option for reformulation of products to reduce TFAs.

One of the main concerns about reformulation of food products is related to the replacement of TFAs with SFAs and hence the potential harms on health of the resulting products. There

has been intense debate about restriction of SFAs and the effect of replacing SFAs with PUFAs on reducing the risk of CHD. A systematic review and meta-analysis study indicated a strong relationship between high SFA and TFA intake and 8–13% higher mortality (Clifton & Keogh, 2017). Reducing SFA and replacing it with any carbohydrate had no effect on CHD events or CVD mortality, although it had a significant effect on reducing total mortality. Only PUFA (not MUFA) replacement of SFA lowered CHD events and CVD and total mortality. Compared to MUFAs, PUFAs have been found to be more effective in reducing mortality (a 19% reduction versus 11%) (Clifton & Keogh, 2017).

Product reformulation based on removal of TFAs from food may increase SFA levels, so limiting the effectiveness of TFA policies (Downs et al., 2013). Although all the studies in the literature conducted on different fatty acids in products showed that pre- and post-policy interventions resulted in reductions in the TFA amounts in foods, there were different findings about SFA amounts in foods (Downs et al., 2017). Product reformulation to reduce TFAs had variable effects on SFA content in different food products, but the total amount of TFAs and SFAs declined in most products. A systematic review showed that reformulation decreased TFA content with little change in SFA content in most products. However, the SFA content of bakery products did not decrease in the reformulation strategy (Downs et al., 2013).

It has been noted that the studies involved in this systematic review were conducted in high-income countries. Multinational companies have reformulated their products to reduce TFA levels, and these products have been sold in high-income countries. On the other hand, the same companies do not want to make such reformulation changes in low- and middle-income countries (Downs et al., 2013). Furthermore, palm oil may also play a role in increasing the level of SFAs. It has been highlighted that a voluntary strategy may be more effective if the agriculture sector is encouraged to grow crops producing oils rich in MUFAs and PUFAs, thereby increasing the supply of suitable alternative oils for product reformulation. The need to provide incentives for smaller-scale producers to reformulate their products in order to reduce the TFA content has also been highlighted (Downs et al., 2013). The systematic review concluded that the reformulation strategy had improved the fatty acid profile of foods in high-income countries. Further research is needed to monitor TFA levels in the food supply to ensure progress continues, particularly in low-income settings.

A summary of the key findings of the systematic reviews relevant to Option 3 are presented in Table 3. For more information about the reviews contained in Table 3 (or to obtain citations for them), please refer to Annexes 2 and 3.

TABLE 3. Summary of key findings from systematic reviews relevant to Option 3 (Introducing incentives to replace industrially produced TFAs with healthier oils and fats)

Category of finding	Key findings
Benefits	Several systematic reviews showed that reformulation of products appeared to be an effective option in reducing the TFA content in food and dietary intake (Downs et al., 2013 and 2017; Hyseni et al., 2017). One review (Downs et al., 2013) showed that voluntary reformulation of TFA levels in the Netherlands had resulted in a 20% reduction in dietary intake.
	Compared to voluntary reformulation, mandatory reformulation has been found to be more successful in eliminating industrial TFA consumption (Downs et al., 2013; Hyseni et al., 2016).
	According to several systematic reviews, reformulation had a positive impact on reducing the risk of CVDs (Clifton & Keogh, 2017; Mozaffarian & Clarke 2009).
	Several evaluation studies reported reductions in the TFA content of margarines and industrially produced foods, particularly when reformulation was mandatory (Hyseni et al., 2017).
Potential harms	One of the main concerns about reformulation of food products is related to replacement of TFAs with SFAs and hence the potential harms on health of the resulting products. A systematic review and meta-analysis study indicated a strong relationship between high SFA and TFA intake and 8–13% higher mortality (Clifton & Keogh, 2017).
	Product reformulation including the removal of TFAs from food may increase levels of SFAs, so limiting the effectiveness of TFA policies (Downs et al., 2013).
	Some alternatives such as palm oil, because of their high availability and low cost, may be used for partial hydrogenation of vegetable oil in some products, but it has high SFA (Downs et al., 2013). Thus, reformulation of foods may simply lead to higher SFA levels in food.
	Economic problems due to industry reformulation costs can be lessened, in the long term, by use of reformulation techniques (Downs et al., 2013).
Resource use, costs and/or cost-effectiveness	One good-quality modelling study of European Union-level policy options investigated the cost-effectiveness of voluntary reformulation compared with no intervention. The study estimated that, over the course of a lifetime (85 years), 2.19 million of 1075 million disability-adjusted life years (DALYs) lost to coronary artery disease could be saved (Hyseni et al., 2017).

Table 3. (Contd)

Category of finding	Key findings
Resource use, costs and/or cost-effectiveness (ontd)	<p>In a study on health outcomes in Argentina, a combined intervention involving food labelling and reformulation of food products was projected, on the basis of changes in lipid profile, to avert 301 deaths and 1066 acute CHD events and to save 5237 DALYs and US\$ 17 million in health-care costs annually in the adult population (Hyseni et al., 2017).</p> <p>One of the main challenges in product reformulation may be finding suitable structuring techniques that can be used for vegetable oils and create products that are of acceptable quality (Downs et al., 2013).</p>
Uncertainty regarding benefits and potential harms (so monitoring and evaluation could be warranted if the option were pursued)	<p>Different types of oil are used in reformulation (Downs et al., 2013; Clifton & Keogh, 2017). It is currently uncertain which type(s) of oil will give the best health results.</p>
Key elements of the policy option if it was tried elsewhere	<p>Setting maximum limits or introducing mandatory regulations limiting use of industrial TFAs was found to encourage food producers to reformulate their products (Downs et al., 2017; Hyseni et al., 2016).</p> <p>Multicomponent interventions including mandatory bans may be more effective than single interventions (Hyseni et al., 2016 and 2017).</p> <p>It has been highlighted that the use of cost-effective alternatives in products will require extensive engagement with industry (Downs et al., 2013).</p>
Stakeholders' views and experiences	<p>The food industry has tended to oppose TFA bans and mandatory food reformulation because of the cost implications. However, the evidence indicates that mandatory policies such as legislation generally have minimal financial effects (Hyseni et al., 2016).</p> <p>It has been reported that food labelling may create "social pressure" on manufacturers to use reformulation strategies, while presenting opportunities to consumers to choose and purchase healthier options (Hyseni et al., 2016).</p> <p>In some countries, where awareness about TFAs is low, reformulation strategies are not adopted by the food industry. In Brazil, TFA levels in some margarines remained at over 50% post regulation, which may be related to a low level of consumer awareness (Downs et al., 2013).</p>

Equity-related observations about the problem

Reducing or even eliminating the consumption of TFAs will positively affect the health status of the population. There is clear evidence that TFA consumption increases the risk factors, incidence and mortality of CVDs and components of diabetes and metabolic syndrome (Monge-Rojas et al., 2017). In general, products high in industrially produced TFAs are more likely to be consumed by people of lower socioeconomic status and the policy approaches that have been developed may not deliver for these people because of their sensitivity to price differentials. Furthermore, consumers with insufficient knowledge of labelling may continue to purchase products that have high amounts of TFA.

The situation with respect to diet and nutrition in Turkey is a combination of problems experienced in developing and developed countries. The nutritional status of people in Turkey varies considerably according to season, socioeconomic level and geographical location (there are differences between urban and rural areas). These factors have an impact on the scope and incidence of nutritional problems. Other relevant factors, such as ignorance about nutrition, inadequate selection of food, and improper preparation, cooking and storage methods, may lead to an increase in the scale of nutritional problems (Ministry of Health/Hacettepe University, 2014).

Policies aimed at reducing TFAs in the food supply have been found to be effective and would likely reduce the burden of diet-related disease, particularly among the most vulnerable socioeconomic groups (Downs et al., 2017).

In sum, policies that contribute to either reducing or eliminating the content of TFA in food may improve the quality of people's diet, especially those of lower socioeconomic status, while ending health inequality (WHO, 2015). Furthermore, public education and extensive media coverage around the country may be required to create public awareness and to prevent worsening inequalities for these people (WHO, 2015).

CONSIDERATIONS IN IMPLEMENTING THE THREE OPTIONS

Potential barriers

Option 1. Establishing mandatory limits on TFAs

Mandatory limits have been effective in controlling the presence of undesirable industrial fat in foods; however, they may have less influence over individual behaviours and food choices (Hendry et al., 2015). In Denmark, a maximum limit of 2% TFAs was imposed on any food product, but it was possible to consume a “high trans menu” of 20–30 g – equivalent to nearly 8–12% of daily energy intake. Even though a new mandatory limit on TFAs in manufactured foods was introduced, some individuals might choose a diet that exceeded dietary recommendations for TFAs. Poor cooking practices might also make a significant contribution to an increase in TFA intake.

Individuals’ socioeconomic situation, behaviours and food preferences may form a potential barrier to implementing mandatory limits on TFAs. An individual’s socioeconomic situation has an effect on their selection of products (Ministry of Health/Hacettepe University, 2014). Socioeconomic factors are responsible for high consumption of pastry products, fast food and street foods because they are preferred by people with low income. In Turkey, bakery products, cookies, biscuits, bagels (*simit & poğaç*), cakes, etc., which are sold without packaging and labels, occupy an important place in the eating habits of every age group. Thus, bakery products, fast-food markets and street food vendors constitute a barrier to implementing mandatory limits on TFAs because of their place in the food sector and consumers’ food preferences.

Monitoring and evaluating the operation of mandatory limits on TFAs may constitute another barrier. The Turkish Ministry of Agriculture and Forestry may not have adequate physical and human resources to check and control compliance with mandatory limits on TFAs. Introducing a legal limit on TFAs also requires that regulations are enforced, and an increase in enforcement would lead to increased monitoring and evaluation costs, which is another significant point to be considered. The cost of monitoring and evaluation would include costs related to product analysis and auditing (WHO, 2015). It has been suggested that continued monitoring would be necessary in order to improve the impact of TFA policies and to ensure sustained progress in reducing TFA content in the food supply (Downs et al., 2017). Even though TFA levels in food in Turkey have shown a gradual tendency to fall over the last 10 years, there are challenges in the control and monitoring of the bakery industry, unpackaged products, restaurant kitchens, fast-food outlets, and homemade products (Daglioglu et al., 2000; Tekin et al., 2002; Karabulut & Turan, 2006; Cirakli, 2011). The bakery industry has a 56% share of the food manufacturing

industry, and this share has increased in recent years (Ministry of Agriculture and Forestry, 2019). There are many domestic and international food companies that play a role in the Turkish food industry. The production of snack foods constitutes a significant business, with imports of more than US\$ 130 million annually. For all these reasons, establishing and managing adequate control, monitoring and evaluation mechanisms to implement Option 1 represents an important challenge.

It is important to consider this option alongside legislation recently introduced in Turkey which requires that fat in food intended for the final consumer and food intended for supply to retail shall not exceed 2 g per 100 g of fat (Official Gazette, 2020). The present document was prepared before this legal regulation was put into effect and laid the groundwork for it.

Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs

The effects of food labelling are complex. It can assist the process of food reformulation by putting pressure on producers and informing consumers about the choices they make. However, its capacity to have these effects depends largely on individual awareness and knowledge and on the population's ability to interpret labels correctly. The trade and investment factors that control the food supply chain may be strong but are still under investigation (Hyseni et al., 2017).

In Turkey, despite voluntary engagement in TFA reduction strategies by some industrial societies (for example, the Kitchen Products and Margarine Industrialists Association (MUMSAD)), there are still a large number of producers and consumers that are not aware of the negative health impacts of TFAs, the definition of TFAs, and the extent of exposure to TFAs. We need more comprehensive local studies on the amount of TFAs in foods. While planning and conducting awareness-raising campaigns, we should focus on the definition of TFAs, the foods containing them, and their negative health impacts. Thus, the complexity involved in TFA reduction and replacement across all areas of the food supply makes it absolutely essential that all sectors (government, industry, public health, academics) work collaboratively to achieve TFA reduction/elimination goals. And for these actions to be successfully implemented, they must be supported both by the media and by consumers conscious of the health concerns associated with TFA intake.

The cultural preference in Turkey, for all age groups, is bakery products such as cookies, biscuits, bagels (*simit & poğaç*) and cakes, and such products are often sold without packaging. At the same time, this type of food is generally preferred by population groups with low income. Such cultural factors influence eating habits, so they must be given full consideration if policies are to be implemented successfully.

Socioeconomic status affects people's diet and food choices, attitudes, knowledge levels, health and food beliefs in various ways, so it is vital that it is considered when policies are implemented. When the relationship between socioeconomic characteristics and diet and nutritional status of individuals is examined, it is apparent that individuals with low socioeconomic status are more vulnerable to diet and health inequalities.

Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats

There are several barriers associated with Option 3, including lack of alternative technology, socioeconomic factors, consumer preferences, and lack of industrial awareness, knowledge and auditing.

■ *Lack of alternative technology*

While the food industry can reformulate products without using the partial hydrogenation technique by using interesterification, fractionation and blending techniques, manufacturers and researchers around the world are working on fat reduction strategies that rely on the use of fat substitutes and fat replacers. Nevertheless, in some cases, such as bakery products, reformulation still seems to present a major challenge. Studies looking at reformulation strategies have shown that, while the TFA content of food products may have decreased, the estimated solid fat intake has generally remained unaffected (Downs et al., 2013). The findings of these studies may be related to addition of SFAs during reformulation. It has also been shown that most manufacturers are not concerned about elevated levels of SFAs due to use of large amounts of palm oil, and hence are not inclined to use PUFAs in product reformulation. However, in order to obtain the greatest health benefits from reformulated products, it has been suggested that TFAs should not be replaced with tropical oils such as palm oil, which are rich in SFAs, but with vegetable oils that have higher amounts of unsaturated fatty acids (Downs et al., 2013). Over the past decade, use of structured solid-like materials has emerged as a technology to provide the functionality of solid fats, but researchers around the world in the emerging field of oil structuring are still continuing to develop their work (Demirkesen & Mert, 2020). Broadly speaking, in Turkey as in the rest of the world, there is still a pressing need for the development of alternative reformulation strategies.

■ *Socioeconomic factors*

The influences of cultural factors on the acceptability of products have also been studied. Rippin et al. (2017) looked at the socioeconomic characteristics of TFA consumers, as well as their food consumption patterns, following voluntary reformulation in the Netherlands and United Kingdom; in each case, the top 10% of TFA consumers were compared with the remaining 90%. In the Netherlands, it was found that the top 10% of TFA consumers were more likely to be women and non-native, and they obtained TFAs from industrial and ruminant sources; they were more likely to be consumers of cakes, buns, pastries, cream and fried potatoes. By contrast, in the United Kingdom there was no significant difference in socioeconomic characteristics between higher and lower TFA consumers; it was observed that the top 10% of TFA consumers were more likely to reside in the Midlands and had a more ruminant-based TFA profile. It was noted that some socioeconomic differences between higher and lower TFA consumers became more evident post reformulation.

In another study (Downs et al., 2013), it was found that multinational companies that had reformulated their products to reduce TFA levels tended to sell them in high-income countries. However, these same companies did not want to make such reformulation changes in low-

and middle-income countries. It was observed that the impetus for product reformulation often came from consumers who valued and demanded products that were low in TFAs; and in countries where awareness of TFAs was low, the food industry tended to be less likely to reformulate their products. Thus, it was suggested that strategies should be used to improve awareness about TFAs, especially in different ethnic or socioeconomic subgroups.

■ *Consumer preferences*

The food industry's concerns about product reformulation include both the costs incurred and consumers' (lack of) acceptance of reformulated products and hence the impact on sales (Downs et al., 2013). Although reformulation of products creates an opportunity to reduce TFAs, it may also raise concerns among consumers, making them less inclined to purchase. The functional roles played by PHVOs, as well as their low cost, mean that maintaining choice for consumers may be difficult. It is important that a wider range of reformulated products is made available to consumers. Thus, government policy and actions are required that encourage not only TFA reduction but also greater variety in food products.

■ *Lack of industrial awareness, knowledge and auditing*

As mentioned in the section on opportunities below, large-scale manufacturers in Turkey are typically more sensitive to TFA reduction through product reformulation than small-scale manufacturers. There is no evidence of awareness and knowledge about alternative technologies among small-scale companies. For example, according to surveys conducted in Turkey, bakery products, which were generally unpackaged products sold in small shops and on the street, had the highest content of TFA (Karabulut, 2007). This might be the result of cultural habits as well as lack of auditing. Downs et al. (2013) emphasize the importance of providing incentives to encourage smaller-scale producers to reformulate their products in order to reduce their TFA content.

Potential opportunities

Option 1. Establishing mandatory limits on TFAs

Industrial TFAs, also known as industrially produced TFAs or hydrogenated fats, are sometimes used in pre-prepared food as a cost-effective way to increase shelf life and improve the texture and taste of baked goods. Many multinational companies have tended to resist using alternative sources of fat to reduce TFA levels in products sold in low- and middle-income countries. However, the evidence indicated that mandatory policies such as legislation generally had minimal financial effects (Hyseni et al., 2017). On the other hand, in the context of Turkey, the food industry may facilitate the implementation of mandatory limits on TFAs, which may be considered a potential opportunity. The Federation of Food and Drink Industry Associations of Turkey (TGDF), which is the largest trade association in the country, encompassing 95% of the food and beverage industry, has engaged in collaborative initiatives with government agencies and has participated in meetings related to preparation and supervision of food

standards (WHO, 2019b). Another representative of the food industry, the Kitchen Products and Margarine Industrialists Association (MUMSAD), which has 90% of the edible oils and fats market in Turkey, is currently open to voluntary collaboration to decrease the level of TFAs in its products (WHO, 2019b). The Turkey Federation of Food Industry (YESIDEF) has, on its own initiative, made announcements through social media to raise awareness of the harms caused by TFA use. In general, large-scale manufacturers in Turkey are more sensitive to the need for TFA elimination than small-scale producers.

There is growing interest among key government stakeholders in supporting passage of draft regulations on mandatory TFA limits. This interest may be encouraged by nongovernmental public health expert groups and public pressure to implement mandatory limits and create demand for healthier foods. Policies helping to limit the content of TFAs in food are expected to improve the quality of the popular diet, especially among people of lower socioeconomic status, and may pave the way to ending health inequalities (WHO, 2015).

Mandatory limits on TFAs create a potential opportunity to inform the public about the negative health impact of industrial TFAs, using the limiting legislation as a springboard to promote healthier lifestyles. It may be attractive to the food industry because establishing mandatory limits on TFAs introduces a standard policy and prevents potentially unfair advantages for specific manufacturers. The systematic reviews considered in this report suggest that limits do not worsen inequalities, but further research is needed in this area.

It should be noted that, after formally setting a 2% TFA limit on food, restrictions on industrially produced TFAs are due to come into force at the end of 2020.

Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs

Communication and cooperation with key stakeholders in the public sector are crucial to support the implementation of the planned arrangements. Advocacy by nongovernmental health expert groups can help promote policies and reforms and play a positive role in increasing public demand for healthier foods. It is also important to consider dialogue with industry representatives in order to ensure successful implementation of policies and increase the level of compliance with the regulations to be applied in the food production sector (WHO, 2019b).

Raising awareness about TFAs among senior policy-makers is an important step in successfully implementing TFA elimination policies. Advocacy by consumer groups to raise TFA awareness among nongovernmental organizations and the public, as well as among policy-makers, may be important to raise the level of success in policy implementation, as public awareness of TFAs is still low. It is also important for successful implementation that prominent people known to have influence in society take part in information and public awareness campaigns.

Furthermore, the fact that food labelling accelerates reformulation of products by putting pressure on producers has an effect on decreasing the TFA intake levels of individuals. This makes it easier for policy-makers and practitioners to implement relevant policies.

Families and educational institutions can be encouraged to promote awareness about the importance and benefits of food labelling, especially for children and young people, by sharing their experiences and motivating each other.

Food labelling is a dynamic and evolving policy area in which the food industry regularly rearranges or eliminates products to meet mandatory or voluntary guidelines. Among the seven dietary factors evaluated in a review by Shangguan et al. (2019), it was found that the food industry had made a significant response to food labelling for TFAs. Therefore, it is thought that implementation of the food labelling option with the support of the food industry can be implemented quickly.

Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats

Some trade associations are playing a role in the collaboration between industry and government agencies. People from such associations are also participating in meetings for preparation and supervision of food standards and are willing to make voluntary commitments to reformulate their products (WHO, 2019b). Such multicomponent interventions could facilitate successful implementation of regulations. In addition, they are an effective way to provide knowledge about alternative reformulation methods and about control of certain parameters such as mixing step, temperature and pressure (etc.) during processing of oils. At the same time, information is provided about industry concerns and its capacity to use reformulation techniques (WHO, 2019b).

In Turkey, there are several financial opportunities available for researchers to develop reformulations as well as for use of new techniques in products. For example, the Scientific and Technological Research Council of Turkey (TUBITAK) has several programmes and funds available to provide financial support for R&D projects. In addition, public institutions and government bodies have R&D budgets. These resources can be used as incentives to encourage advanced research in the field of creating alternatives to TFAs. Financial support may also be provided for R&D projects on the collection and recycling of waste oils as fuels and vehicle waste oil management.

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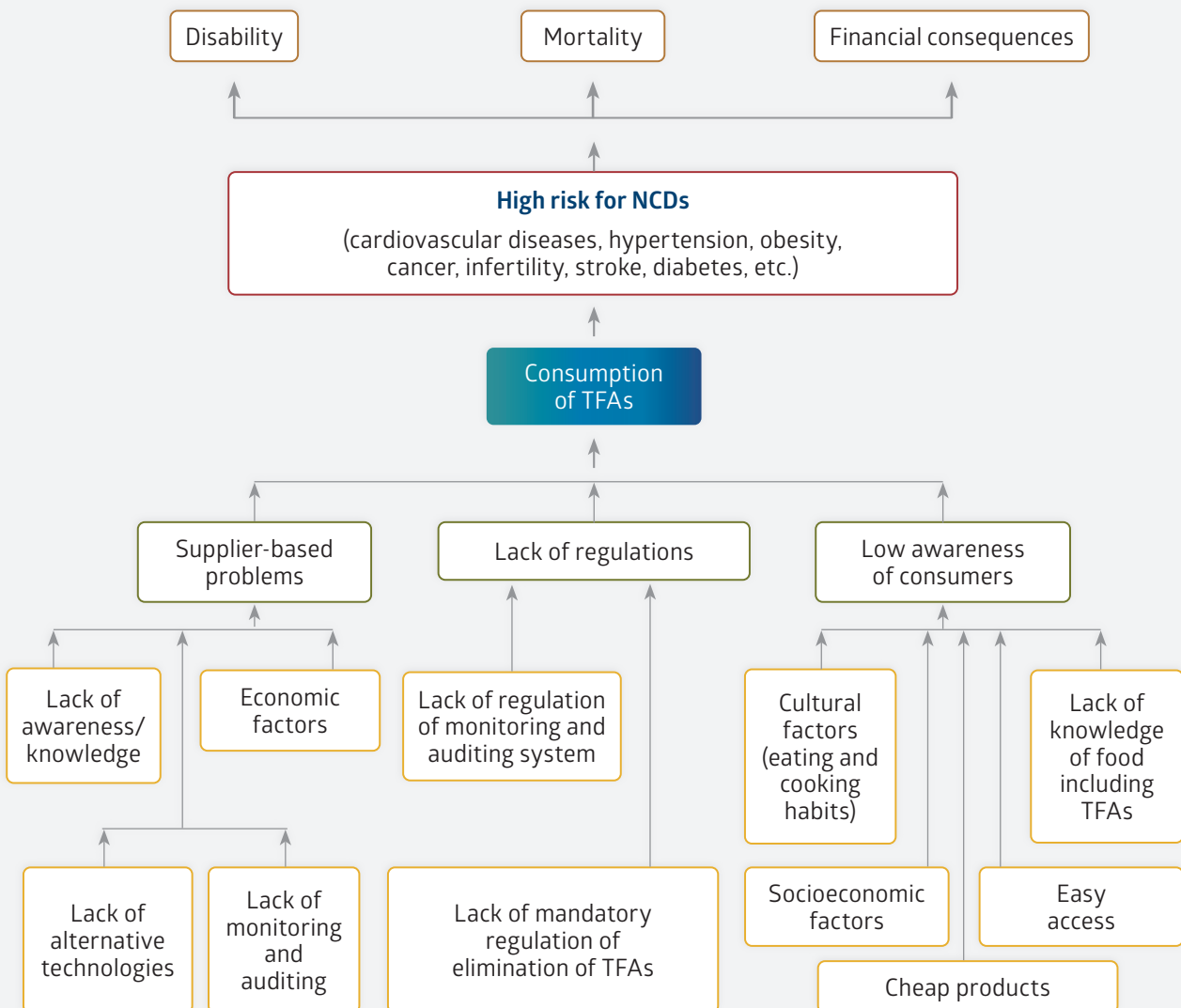
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Wu J, Downs S, Catterall E, Bloem M, Zheng M, Veerman L et al. (2017). Levels of trans fats in the food supply and population consumption in Australia: an Expert Commentary rapid review brokered by the Sax Institute for the National Heart Foundation of Australia. Sydney: Sax Institute (<https://www.heartfoundation.org.au/getmedia/e27233c8-73d5-4c37-9416-ad7592af593c/Expert-Commentary-Levels-of-trans-fats-in-the-food-supply-and-consumption-in-Australia.pdf>, accessed 25 November 2020).

Annex 1. Building blocks of the TFA consumption problem tree



Annex 2. Summary of the systematic scientific literature search

Option/options	Systematic review	Rating	Inclusion in EBP
<p>Option 1. Establishing mandatory limits on TFAs</p> <p>Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs</p> <p>Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats</p>	<p>Downs S, Thow A, Leeder S (2013). The effectiveness of policies for reducing dietary trans fat: a systematic review of the evidence. Bull World Health Organ. 91:262–9h</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>Included</p>
<p>Option 1. Establishing mandatory limits on TFAs</p> <p>Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats</p>	<p>Downs S, Bloem M, Zheng M, Catterall E, Thomas B, Veerman L et al. (2017). The impact of policies to reduce trans fat consumption: a systematic review of the evidence. Curr Dev Nutr. 1(12):cdn.117.000778</p>	<p>AMSTAR: 5/11</p>	<p>Included</p>
<p>Option 1. Establishing mandatory limits on TFAs</p>	<p>Hendry V, Almiron-Roig E, Monsivais P, Jebb S, Benjamin Neelon S, Griffin S et al. (2015). Impact of regulatory interventions to reduce intake of artificial trans-fatty acids: a systematic review. Am J Public Health. 105(3):e32–e42.</p>	<p>AMSTAR: 7/11</p>	<p>Included</p>
<p>Option 1. Establishing mandatory limits on TFAs</p> <p>Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs</p> <p>Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats</p>	<p>Hyseni L, Atkinson M, Bromley H, Orton L, Lloyd-Williams F, McGill R et al. (2016). The effects of policy actions to improve population dietary patterns and prevent diet-related non-communicable diseases: scoping review. Eur J Clin Nutr. 71(6):694</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>Included</p>
<p>Option 1. Establishing mandatory limits on TFAs</p> <p>Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs</p> <p>Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats</p>	<p>Hyseni L, Bromley H, Kypridemos C, O’Flaherty M, Lloyd-Williams F, Guzman-Castillo M et al. (2017). Systematic review of dietary trans-fat reduction interventions. Bull World Health Organ. 95(12):821</p>	<p>Health Evidence: 8/10 (strong)</p>	<p>Included</p>

Annex 2 (Contd)

Option/options	Systematic review	Rating	Inclusion in EBP
Option 1. Establishing mandatory limits on TFAs	McGill R, Anwar E, Orton L, Bromley H, Lloyd-Williams F, O'Flaherty M et al. (2015). Are interventions to promote healthy eating equally effective for all? Systematic review of socioeconomic inequalities in impact. BMC Public Health. 15(1):457	Health Evidence: 7/10 (moderate)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Al-Khudairy L, Uthman O, Walmsley R, Johnson S, Oyeboode O (2019). Choice architecture interventions to improve diet and/or dietary behaviour by healthcare staff in high-income countries: a systematic review. BMJ Open. 9(1):e023687	AMSTAR: 8/10 (strong)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Cecchini M, Warin L (2016). Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. Obes Rev. 17(3):201–10	Health Evidence: 6/10 (moderate)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Christoph M, An R (2018). Effect of nutrition labels on dietary quality among college students: a systematic review and meta-analysis. Nutr Rev. 76(3):187–203	Health Evidence: 7/10 (moderate)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Fernandes A, Oliveira R, Proença R, Curioni C, Rodrigues V, Fiates G (2016). Influence of menu labelling on food choices in real-life settings: a systematic review. Nutr Rev. 74(8):534–48	Health Evidence: 6/10 (moderate)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Sarink D, Peeters A, Freak-Poli R, Beauchamp A, Woods J, Ball K et al. (2016). The impact of menu energy labelling across socioeconomic groups: a systematic review. Appetite. 99:59–75	Health Evidence: 7/10 (moderate)	Included

Annex 2 (Contd)

Option/options	Systematic review	Rating	Inclusion in EBP
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Shangguan S, Afshin A, Shulkin M, Ma W, Marsden D, Smith J et al. (2019). A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. <i>Am J Prev Med.</i> 56(2):300–14	AMSTAR: 7/11	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Sinclair S, Cooper M, Mansfield E (2014). The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. <i>J Acad Nutr Diet.</i> 114(9):1375–88	Health Evidence: 7/10 (strong)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Swartz J, Braxton D, Viera A (2011). Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. <i>Int J Behav Nutr Phys Act.</i> 8(1):135	Health Evidence: 7/10 (strong)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Crockett R, King S, Marteau T, Prevost A, Bignardi G, Roberts N et al. (2018). Nutritional labelling for healthier food or non-alcoholic drink purchasing and consumption. <i>Cochrane Database Syst Rev.</i> 2(2):CD009315	Health Evidence: 9/10 (strong)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	von Philipsborn P, Stratil J, Burns J, Busert L, Pfadenhauer L, Polus S et al. (2019). Environmental interventions to reduce the consumption of sugar-sweetened beverages and their effects on health. <i>Cochrane Database Syst Rev.</i> 6(6):CD012292	AMSTAR: 11/11	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Kliemann N, Kraemer M, Scapin T, Rodrigues V, Fernandes A, Bernardo G et al. (2018). Serving size and nutrition labelling: implications for nutrition information and nutrition claims on packaged foods. <i>Nutrients.</i> 10(7):891	AMSTAR: 3/9	Not Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Mozaffarian D, Afshin A, Benowitz N, Bittner V, Daniels S, Franch H et al. (2012). Population approaches to improve diet, physical activity, and smoking habits: a scientific statement from the American Heart Association. <i>Circulation.</i> 126(12):1514–63	Health Evidence: 6/10 (moderate)	Included

Annex 2 (Contd)

Option/options	Systematic review	Rating	Inclusion in EBP
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Meiklejohn S, Ryan L, Palermo C (2016) . A systematic review of the impact of multi-strategy nutrition education programs on health and nutrition of adolescents. <i>J Nutr Educ Behav.</i> 48(9):631–46	Health Evidence: 7/10 (strong)	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Ashton L, Sharkey T, Whatnall M, Williams R, Bezzina A, Aguiar E et al. (2019) . Effectiveness of interventions and behaviour change techniques for improving dietary intake in young adults: a systematic review and meta-analysis of RCTs. <i>Nutrients.</i> 11(4):825	Health Evidence 9/10	Included
Option 2. Labelling TFA-free foods and raising awareness of the health effects associated with TFAs	Mita G, Ni Mhurchu C, Jull A (2016) . Effectiveness of social media in reducing risk factors for noncommunicable diseases: a systematic review and meta-analysis of randomized controlled trials. <i>Nutr Rev.</i> 74(4):237–47	AMSTAR: 10/11	Included
Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats	Mozaffarian D, Clarke R (2009) . Quantitative effects on cardiovascular risk factors and coronary heart disease risk of replacing partially hydrogenated vegetable oils with other fats and oils. <i>Eur J Clin Nutr.</i> 63 Suppl 2:S22–33	Health Evidence: 5/10 (moderate)	Included
Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats	Clifton P, Keogh J (2017) . A systematic review of the effect of dietary saturated and polyunsaturated fat on heart disease. <i>Nutr Metab Cardiovasc Dis.</i> 27(12):1060–80	Health Evidence: 5/10 (moderate)	Included
Option 3. Introducing incentives to replace industrially produced TFAs with healthier oils and fats	Makarewicz-Wujec M, Dworakowska A, Kozłowska-Wojciechowska M (2018) . Replacement of saturated and trans-fatty acids in the diet v. CVD risk in the light of the most recent studies. <i>Public Health Nutr.</i> 21(12):2291–300	AMSTAR: 2/11	Not Included

Annex 3. Summary of systematic reviews relevant to Option 1, Option 2 and Option 3

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>Downs S, Thow A, Leeder S (2013). The effectiveness of policies for reducing dietary trans fat: a systematic review of the evidence. Bull World Health Organ. 91:262–9h</p>	<p>Effectiveness of policies in reducing dietary TFAs and their negative impacts on health.</p>	<p>For Option 1, Option 2 and Option 3: All policy interventions aimed at restricting the TFA levels in food, including voluntary self-regulation, labelling, voluntary limits, reformulation of products, and local and national bans, resulted in a significant decrease in TFA levels. Policies introduced to decrease TFA levels in the food supply were effective regardless of the intervention employed. There had been significant progress with labelling regulation and other voluntary-based regulation; but the most effective policy interventions were found to be national and local bans. Some WHO Member States also indicated that they preferred a voluntary to a mandatory approach to reducing TFAs, because mandatory regulation appeared to be more effective in reducing TFA levels. Another important finding of the systematic review was that reformulation of products appeared to be an effective option in reducing the TFA content in food and dietary intake. Compared to voluntary reformulation, mandatory reformulation was found to be more successful in eliminating industrial TFA consumption. Economic problems caused by industry reformulation costs could be improved with the use of reformulation techniques in the long term.</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>26 studies were included, six of which were conducted in Europe.</p>
<p>Downs S, Bloem M, Zheng M, Catterall E, Thomas B, Veerman L et al. (2017). The impact of policies to reduce trans fat consumption: a systematic review of the evidence. Curr Dev Nutr. 1(12):cdn.117.000778</p>	<p>Effectiveness of policies aimed at reducing TFAs in the food supply.</p>	<p>For Option 1 and Option 3: All types of TFA policies led to reduction in TFA levels in the food supply; however, stronger policies (e.g. limits/bans) had a greater impact (virtually eliminating TFA) than voluntary approaches (ranged from 20–38% reduction in TFA intakes) or labelling approaches (ranged from 30–74% reduction in TFA intakes, plasma serum or breast-milk concentrations). Moreover, TFA bans probably contributed to reductions in heart disease risk and there was some evidence to suggest that they were cost-saving, as demonstrated in the modelling studies included in this review. Product reformulation to reduce TFAs had variable effects on saturated fatty acid (SFA) contents in these foods; however, the combined amount of TFAs and SFAs declined in most products.</p>	<p>AMSTAR: 5/11</p>	<p>31 studies were included, eight of which were conducted in Europe.</p>
<p>Hendry V, Almiron-Roig E, Monsivais P, Jebb S, Benjamin Neelon S, Griffin S et al. (2015). Impact of regulatory interventions to reduce intake of artificial trans-fatty acids: a systematic review. Am J Public Health. 105(3):e32–e42.</p>	<p>Regulatory interventions to reduce intake of TFAs and their impacts.</p>	<p>For Option 1: Regulations based on maximum limits and mandated labelling could cause a decrease in actual and reported TFAs in food items for sale. Such regulations had also encouraged food producers to reformulate their products. The review claimed that governments had the power to make interventions that could eliminate consumption of artificial TFAs. Studies of maximum limits on artificial TFAs and of labelling mandates found that there was a good level of compliance with regulations, which appeared to effectively reduce artificial TFA levels in food items.</p>	<p>AMSTAR: 7/11</p>	<p>14 studies were included, four of which were conducted in Europe.</p>

Annex 3 (Contd)

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>Hyseni L, Atkinson M, Bromley H, Orton L, Lloyd-Williams F, McGill R et al. (2016). The effects of policy actions to improve population dietary patterns and prevent diet-related non-communicable diseases: scoping review. Eur J Clin Nutr. 71(6):694</p>	<p>Effectiveness of policy interventions (including taxes, subsidies, reformulation, elimination, labelling, campaigns, marketing, advertisement, workplace, schools, community, food system, food supply chain, food trade, food investment, legislation, regulation, or equivalents of these terms) to improve healthy food consumption and thus prevent diet-related NCDs.</p>	<p>For Option 1, Option 2 and Option 3: Diverse policy interventions were used to improve healthy eating and thus prevent NCDs. The evidence base studies differed for each category; the studies of price interventions appeared to be comprehensive and included studies mostly on taxing sugar-sweetened beverages (SSBs), followed by taxing dietary fat. Mandatory reformulation was found to be more effective than voluntary reformulation. The Denmark TFAs case asserted that voluntary reformulation could be effective at the beginning; however, a legislative ban could be used to essentially eliminate industrial TFA consumption. In addition, reformulation to reduce industrial TFA intake seemed to be very effective.</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>58 studies included, 36 of which were conducted in Europe.</p>
<p>Hyseni L, Bromley H, Kypridemos C, O’Flaherty M, Lloyd-Williams F, Guzman-Castillo M et al. (2017). Systematic review of dietary trans-fat reduction interventions. Bull World Health Organ. 95(12):821</p>	<p>Initiatives to reduce the intake of dietary TFAs.</p>	<p>For Option 1, Option 2 and Option 3: Multicomponent interventions including legislation to eliminate TFAs from food products were the most effective strategy. Reformulation of food products and other multicomponent interventions also achieved useful reductions in TFA intake. For example, regulations mandating reformulation of food reduced TFA content by about 2.4 g/day. By contrast, interventions targeted at individuals consistently achieved smaller reductions. Future prevention strategies should consider this effectiveness hierarchy to achieve the largest reductions in TFA consumption. The review suggested that multicomponent interventions achieved the biggest reductions in TFA consumption across an entire population, as demonstrated in Denmark, Canada and Costa Rica. Systematic reformulation of products containing TFAs could also help, as was observed in Canada and the USA. Interventions targeting individuals typically achieved smaller reductions in TFA consumption.</p>	<p>Health Evidence: 8/10 (strong)</p>	<p>23 studies were included, 10 of which were conducted in Europe.</p>
<p>McGill R, Anwar E, Orton L, Bromley H, Lloyd-Williams F, O’Flaherty M et al. (2015). Are interventions to promote healthy eating equally effective for all? Systematic review of socioeconomic inequalities in impact. BMC Public Health. 15(1):457</p>	<p>Evaluations of interventions to promote healthy nutrition and related socioeconomic inequalities.</p>	<p>For Option 1: Interventions categorized as “Price”, “Place”, “Product”, “Prescriptive”, “Promotion” and “Person” had different effects on healthy eating outcomes according to socioeconomic position. Upstream interventions categorized as “Price” seemed to decrease inequalities, while downstream interventions categorized as “Person” appeared to increase inequalities. Price interventions were most effective in groups with low socioeconomic position and appeared likely to reduce inequalities. All policy interventions that combined taxes and subsidies appeared to consistently decrease inequalities.</p>	<p>Health Evidence: 7/10 (moderate)</p>	<p>36 studies were included, 20 of which were conducted in Europe.</p>

Annex 3 (Contd)

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>Al-Khudairy L, Uthman O, Walmsley R, Johnson S, Oyeboode O (2019). Choice architecture interventions to improve diet and/or dietary behaviour by healthcare staff in high-income countries: a systematic review. BMJ Open. 9(1):e023687</p>	<p>To synthesize the evidence on choice architecture interventions to increase healthy purchasing and/or consumption of food and drink by National Health Service staff.</p>	<p>For Option 2: Labelling alone was generally not effective at changing purchasing behaviour. Interventions including an availability element were generally reported to be successful at changing behaviour, but none of the studies included examined this element alone. There was no strong evidence for the effect of pricing on purchasing or dietary intake.</p>	<p>AMSTAR: 8/10 (strong)</p>	<p>16 studies were included, all of them conducted in Europe.</p>
<p>Cecchini M, Warin L (2016). Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. Obes Rev. 17(3):201–10</p>	<p>To assess the effectiveness of food labelling in increasing the selection of healthier products and in reducing calorie intake.</p>	<p>For Option 2: Food labelling would increase the amount of people selecting a healthier food product by about 18% (confidence interval: +11.24% to +24.66%). Food labelling would also decrease calorie intake/choice by about 3.59% (confidence interval: 8.90% to +1.72%). The findings of this study suggest that nutrition labelling may be an effective approach to empowering consumers in choosing healthier products. Interpretive labels, as traffic light labels, may be more effective.</p>	<p>Health Evidence: 6/10 (moderate)</p>	<p>Nine studies were included, three of which were conducted in Europe.</p>
<p>Christoph M, An R (2018). Effect of nutrition labels on dietary quality among college students: a systematic review and meta-analysis. Nutr Rev. 76(3):187–203</p>	<p>To examine and quantify the effect of nutrition labels on diet quality in college students.</p>	<p>For Option 2: The review reported that exposure to nutrition labels led to improved dietary choices. Nine of the 12 studies measuring noncaloric measures of dietary quality such as food group choices found that introducing labels improved dietary quality.</p>	<p>Health Evidence: 7/10 (moderate)</p>	<p>22 studies were included, four of which were conducted in Europe.</p>
<p>Fernandes A, Oliveira R, Proença R, Curioni C, Rodrigues V, Fiates G (2016). Influence of menu labelling on food choices in real-life settings: a systematic review. Nutr Rev. 74(8):534–48</p>	<p>To assess the influence of diverse menu-labelling formats on food choices in real-life settings.</p>	<p>For Option 2: The results were mixed, but a partial influence of menu labelling on food choices was more frequent than an overall influence or no influence. Menu labelling was more effective in cafeterias than in restaurants. Qualitative information, such as healthy food symbols and traffic-light labelling, was most effective in promoting healthy eating.</p>	<p>Health Evidence: 6/10 (moderate)</p>	<p>38 studies were included, six of which were conducted in Europe.</p>
<p>Sarink D, Peeters A, Freak-Poli R, Beauchamp A, Woods J, Ball K et al. (2016). The impact of menu energy labelling across socioeconomic groups: a systematic review. Appetite. 99:59–75</p>	<p>To summarize evidence on the effectiveness of menu energy labelling by socioeconomic position.</p>	<p>For Option 2: Eighteen papers were identified. Of 12 studies reporting the effect of menu energy labelling in populations of low socioeconomic position, six reported on purchase outcomes. All but one of these reported no positive effect of the policy on this population. Two of the five studies that compared purchase outcomes of menu labelling across groups of different socioeconomic positions reported that the policy was effective overall.</p>	<p>Health Evidence: 7/10 (moderate)</p>	<p>18 studies were included, none of which were conducted in Europe.</p>

Annex 3 (Contd)

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>Shangguan S, Afshin A, Shulkin M, Ma W, Marsden D, Smith J et al. (2019). A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. Am J Prev Med. 56(2):300–14</p>	<p>To characterize the quantitative effects of labelling across multiple approaches, using a systematic review and meta-analysis; to provide effects estimates, uncertainties, and heterogeneities including stratified analyses; and to assess responses of both consumers and industry.</p>	<p>For Option 2: In this systematic review and meta-analysis of 60 studies, including 111 intervention arms and more than 2 million observations across 11 countries, food labelling reduced consumer consumption of total energy and total fat, while increasing consumption of vegetables. This meta-analysis also found that food labelling altered industry formulations for sodium and TFA, but did not significantly affect product formulations for total energy, saturated fat, dietary fibre, or other healthy/unhealthy dietary components.</p>	<p>AMSTAR: 7/11</p>	<p>60 studies were included, 14 of which were conducted in Europe.</p>
<p>Sinclair S, Cooper M, Mansfield E (2014). The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. J Acad Nutr Diet. 114(9):1375–88</p>	<p>To determine whether the provision of menu-based nutrition information affects the selection and consumption of calories in restaurants and other food service establishments. A secondary objective was to determine whether the format of nutrition information (informative versus contextual or interpretive) influences calorie selection or consumption.</p>	<p>For Option 2: Menu labelling with calories alone did not have the intended effect of decreasing calories selected or consumed (e31 kcal [P¼0.35] and e13 kcal [P¼0.61], respectively). The addition of contextual or interpretive nutrition information on menus appeared to assist consumers in the selection and consumption of fewer calories (e67 kcal [P¼0.008] and e81 kcal [P¼0.007], respectively). Sex influenced the effect of menu labelling on selection and consumption of calories, with women using the information to select and consume fewer calories.</p>	<p>Health Evidence: 7/10 (strong)</p>	<p>17 studies were included, one of which was conducted in Europe.</p>
<p>Swartz J, Braxton D, Viera A (2011). Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. Int J Behav Nutr Phys Act. 8(1):135</p>	<p>To use current literature to address the question of whether calorie labelling on menus in restaurants and cafeterias has an effect on consumer purchasing and eating behaviours.</p>	<p>For Option 2: The studies included used an experimental or quasi-experimental design comparing a calorie-labelled menu with a no-calorie menu and were conducted in laboratories, college cafeterias and fast-food restaurants.</p>	<p>Health Evidence: 7/10 (strong)</p>	<p>Seven studies were included, none of which were conducted in Europe.</p>
<p>Crockett R, King S, Marteau T, Prevost A, Bignardi G, Roberts N et al. (2018). Nutritional labelling for healthier food or non-alcoholic drink purchasing and consumption. Cochrane Database Syst Rev. 2(2):CD009315</p>	<p>The primary objective was to assess whether nutrition labelling of foods (in comparison to the same foods presented either without a label or with an incomplete label) promotes: (1) healthier food purchasing behaviour from (a) restaurants, (b) food shops, or (c) vending machines; or (2) healthier food consumption behaviour. The secondary objective was to explore possible modifiers of the effect of nutrition labelling on purchasing and consumption.</p>	<p>For Option 2: The use of nutritional labels may have an impact not only on individuals who purchase food or individuals who consume food (or both), but also on the food industry in terms of encouraging reformulation of products so that foods meet the standards required to display labels indicating healthier purchases.</p>	<p>Health Evidence: 9/10 (strong)</p>	<p>28 studies were included, three of which were conducted in Europe.</p>

Annex 3 (Contd)

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>von Philipsborn P, Stratil J, Burns J, Busert L, Pfadenhauer L, Polus S et al. (2019). Environmental interventions to reduce the consumption of sugar-sweetened beverages and their effects on health. Cochrane Database Syst Rev. 6(6):CD012292</p>	<p>To assess the effects of environmental interventions (excluding taxation) on the consumption of sugar-sweetened beverages (SSBs) and sugar-sweetened milk, diet-related anthropometric measures and health outcomes, and on any reported unintended consequences or adverse outcomes.</p>	<p>For Option 2: The review found moderate-certainty evidence that traffic-light labelling is associated with decreasing sales of SSBs, and low-certainty evidence that nutritional rating score labelling is associated with decreasing sales of SSBs. For menu board calorie labelling, reported effects on SSB sales varied.</p>	<p>AMSTAR: 11/11</p>	<p>58 studies were included, eight of which were conducted in Europe.</p>
<p>Mozaffarian D, Afshin A, Benowitz N, Bittner V, Daniels S, Franch H et al. (2012). Population approaches to improve diet, physical activity, and smoking habits: a scientific statement from the American Heart Association. Circulation. 126(12):1514–63</p>	<p>Poor lifestyle behaviours, including suboptimal diet, physical inactivity and tobacco use, are leading causes of preventable diseases globally. Although even modest population shifts in risk substantially alter health outcomes, the optimal population-level approaches to improve lifestyle are not well established.</p>	<p>For Option 2: There was limited or inconsistent evidence to evaluate the potential heterogeneity of effects, depending (for example) on the population (children, adults, specific vulnerable subgroups, etc.) or level of intervention (local, state, federal). For some strategies, such as media and educational campaigns or labelling and information approaches, a few studies suggested less effectiveness or awareness in lower education or minority subgroups, but others did not. This systematic review identified and graded a range of evidence-based population-based strategies to effectively promote lifestyle change. The findings inform potential partnerships and strategies to successfully address suboptimal diet, inactivity and smoking, all of which are major preventable causes of poor health globally. New strategic initiatives and partnerships are needed to translate this evidence into action.</p>	<p>Health Evidence: 6/10 (moderate)</p>	<p>216 studies were included, 56 of which were conducted in Europe.</p>
<p>Meiklejohn S, Ryan L, Palermo C (2016). A systematic review of the impact of multi-strategy nutrition education programs on health and nutrition of adolescents. J Nutr Educ Behav. 48(9):631–46</p>	<p>To update evidence on the impact of multi-strategy nutrition education interventions on adolescents' health and nutrition outcomes and behaviours.</p>	<p>For Option 2: Four studies reported significant changes in anthropometric measures and nine showed significant changes in dietary intake. Type of nutrition education varied. Components of the interventions that showed statistically significant changes in anthropometric and dietary intake included facilitation of the programmes by school staff and teachers, parental involvement, and using theoretical models to guide the intervention's development. Changes in canteens, food supply and vending machines were associated with significant changes in dietary intake.</p>	<p>Health Evidence: 7/10 (strong)</p>	<p>11 studies were included, seven of which were conducted in Europe.</p>
<p>Ashton L, Sharkey T, Whatnall M, Williams R, Bezzina A, Aguiar E et al. (2019). Effectiveness of interventions and behaviour change techniques for improving dietary intake in young adults: a systematic review and meta-analysis of RCTs. Nutrients. 11(4):825</p>	<p>The aims of this review were to evaluate the effectiveness of interventions aiming to improve dietary intake among healthy young adults (aged 17–35 years) and to identify the behaviour change techniques (BCTs) used in these interventions and determine which are most effective.</p>	<p>For Option 2: The BCTs with the highest effectiveness ratio were habit formation (100%), salience of consequences (83%) and adding objects to the environment (70%). The review highlighted the potential of behavioural interventions to improve young adults' fruit and vegetable intake but was less convincing for other dietary outcomes. Because of a lack of studies including each BCT, the BCTs imperative to success could not be identified.</p>	<p>Health Evidence: 9/10</p>	<p>54 studies were included, five of which were conducted in Europe.</p>

Annex 3 (Contd)

Annex 3 (Contd)

Systematic review	Focus of systematic review	Main findings (for each option)	Rating	Proportion of studies conducted in Europe
<p>Mita G, Ni Mhurchu C, Jull A (2016). Effectiveness of social media in reducing risk factors for noncommunicable diseases: a systematic review and meta-analysis of randomized controlled trials. Nutr Rev. 74(4):237-47</p>	<p>The primary aim of the study was to synthesize evidence of the effect of social media use (compared with no social media use) as part of interventions to reduce risk factors for NCDs.</p>	<p>For Option 2: Meta-analysis of all trials showed no significant differences (standardized mean difference [SMD] 0.14; 95% CI 0.28 to 0.01), with similar findings for physical activity (SMD 0.07; 95% CI 0.25 to 0.38), body weight (SMD 0.07; 95% CI 0.17 to 0.20), and fruit and vegetable intake (SMD 0.39; 95% CI 0.11 to 0.89). Trials assessing social media interventions aimed at modifying NCD risk factors showed that social media use improved the primary outcomes, but the overall quality of the included studies limited the generalizability of these findings.</p>	<p>AMSTAR: 10/11</p>	<p>16 studies were included, two of which were conducted in Europe.</p>
<p>Mozaffarian D, Clarke R (2009). Quantitative effects on cardiovascular risk factors and coronary heart disease risk of replacing partially hydrogenated vegetable oils with other fats and oils. Eur J Clin Nutr. 63 Suppl 2:S22-33</p>	<p>Quantitative estimates of coronary heart disease (CHD) effects if a person's consumption of partially hydrogenated vegetable oils (PHVOs) were to be replaced with alternative fats and oils based on randomized dietary trials and prospective observational studies.</p>	<p>For Option 3: PHVOs that contain both TFAs and other fatty acids are the unit of replacement and could be replaced with diverse alternative fats and oils. Effects on CHD risk of removing PHVOs from a person's diet vary depending on the TFA content of the PHVOs and the fatty acid composition of the replacement fat or oil, with direct implications for reformulation of individual food products.</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>17 studies were included, nine of which were conducted in Europe.</p>
<p>Clifton P, Keogh J (2017). A systematic review of the effect of dietary saturated and polyunsaturated fat on heart disease. Nutr Metab Cardiovasc Dis. 27(12):1060-80</p>	<p>To examine systematic reviews and meta-analyses that advise reducing saturated fat and increasing polyunsaturated fat to reduce CVD risk.</p>	<p>For Option 3: Reducing saturated fat and replacing it with carbohydrate will not lower CHD events or CVD mortality, although it will reduce total mortality. Replacing saturated fat with PUFA, MUFA or high-quality carbohydrate will lower CHD events. One of the main concerns about reformulation of food products can be related to the replacement of TFAs with SFAs and hence the potential harms on health of the resulting products.</p>	<p>Health Evidence: 5/10 (moderate)</p>	<p>25 studies were included, 15 of which were conducted in Europe.</p>

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WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR EUROPE
UN City, Marmorvej 51
DK-2100 Copenhagen Ø,
Denmark

Tel.: +45 45 33 70 00
Fax: +45 45 33 70 01
E-mail: euwhocontact@who.int
Web: www.euro.who.int



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