

# Impact of WHO recommendations to eliminate industrial *trans*-fatty acids from the food supply in Latin America and the Caribbean

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**Background** The World Health Organization (WHO) has deemed that there is enough evidence to recommend the elimination of industrially produced *trans*-fatty acids (TFA) from the food supply. This article evaluates government-led public health strategies in countries in Latin America and the Caribbean (LAC), and factors perceived to affect following WHO's recommendation to eliminate industrially produced TFA.

**Methods** Descriptive, prospective multiple case studies integrated data from open-ended questionnaires to representatives of ministries of health, and systematic review of internal and publicly available documents in 13 LAC countries.

**Findings** Overall, government efforts to follow WHO recommendations have not been well co-ordinated throughout the region. Evidence for this includes the lack of standardization of TFA definitions. For example, some countries exclude naturally occurring TFA from the definitions, whereas others leave the option open to their inclusion. As a consequence, the criteria for *trans*-free nutrient claims and labelling requirements are inconsistent across the region. Government-led strategies varied from banning or limiting TFA content in the food supply to voluntary labelling of TFA. The identified challenges to the implementation of policies to reduce TFA include the shortage of information on TFA content of diets and foods, consumer unawareness of TFA and lack of monitoring and surveillance. The identified enabling factors were intersectoral collaboration with industry, mandatory labelling regulation and international and national visibility of the topic, which facilitated reduction of TFA content.

**Interpretation** A co-ordinated effort is required to achieve virtual elimination of all TFA in the region, as recommended by WHO. Standardization of the definition of TFA across the region would facilitate regulation, consumer education efforts and monitoring and surveillance efforts. Simultaneously, countries need to determine their level of exposure to TFA through the implementation of small surveys to assess blood TFA levels using blood spots, and the evaluation of TFA in fat sources that are commonly used.

**Keywords** *trans*-fatty acids, regulation, nutritional labelling, Latin America and Caribbean, nutrition policy

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## KEY MESSAGES

- Government efforts to follow WHO recommendations have not been well co-ordinated throughout the region.
- There is a lack of standardization of TFA definitions, with some countries excluding naturally occurring TFA from the definitions, whereas others leave the option open to their inclusion. This lack of standardization stems from lack of consensus in the process to define TFA and has consequences on the criteria for *trans*-free nutrient claims and labelling requirements inconsistency across the region.
- Government-led public health strategies varied from banning or limiting TFA content in the food supply to voluntary labelling of TFA. Shortage of information on TFA content of diets and foods, consumer unawareness of TFA and lack of monitoring and surveillance were challenges to implementation of public health regulations, while intersectoral collaboration with industry, mandatory labelling regulation and international and national visibility of the topic were mentioned as facilitating factors in the reduction of TFA content.
- A co-ordinated effort is required to achieve virtual elimination of TFA in the region, as recommended by WHO. Consensus on the definition of TFA across the region would facilitate regulation, consumer education efforts and monitoring and surveillance efforts. Simultaneously, countries need to determine their level of exposure to TFA through the implementation of small surveys to assess blood TFA levels, and the evaluation of TFA in fat sources that are commonly used.

## Introduction

Evidence about the negative health effects of industrial *trans*-fatty acids (TFA) has produced a call towards the global reduction of partially hydrogenated oils (Erkkila *et al.* 2008; Mozaffarian *et al.* 2009; Teegala *et al.* 2009). Industrial TFA are found in products that were partially hydrogenated; naturally formed TFA are also found in the fat of ruminant products (dairy and meats), though consumed in much smaller quantities compared with those originating from partial hydrogenation. The consensus of the scientific community is that, at the amounts usually consumed, ruminant TFA have neither beneficial nor harmful effects to health (Teegala *et al.* 2009). In 2007, the World Health Organization (WHO) Scientific Update deemed there was enough evidence to recommend the elimination of industrially produced TFA, in agreement with the Global Strategy on Diet, Physical Activity and Health (Nishida and Uauy 2009). Simultaneously, in 2007, the regional office of WHO in the Americas [the Pan American Health Organization (PAHO/WHO)] recommended the elimination of industrial TFA from all foodstuffs in the Americas (PAHO 2007). Government-led public health strategies to remove TFA from the food supply have been documented in peer-reviewed literature in Denmark, Canada and the USA (Leth *et al.* 2006; L'Abbe *et al.* 2009; Tan 2009); however, little is known about what is happening in low- and middle-income countries to comply with WHO's recommendation to virtually eliminate TFA from the food supply.

Burden of non-communicable diseases, particularly heart disease, is increasing steadily in low- and middle-income countries (Ebrahim and Smeeth 2005). Approaches to reduce or ban TFA content have led to changes in the fatty acid composition of foods (Leth *et al.* 2006; Baylin *et al.* 2007; Angell *et al.* 2009; L'Abbe *et al.* 2009; Mozaffarian *et al.* 2010), reduction in TFA biomarkers (Colon-Ramos *et al.* 2006; Friesen and Innis 2006) and decreased or disappeared associations between TFA and ischaemic heart disease in Scandinavian countries and in Costa Rica (Colon-Ramos *et al.* 2006; L'Abbe *et al.* 2009). Thus, it is likely that the development

and implementation of policies to eliminate industrial TFA from the food supply in low- and middle-income countries will have a major impact on the WHO's goal to achieve a 25% reduction in mortality from non-communicable diseases by 2025 in these countries (Beaglehole *et al.* 2012). However, there is very little information on the actions taken by governments to comply with the WHO's recommendation on TFA (Mozaffarian and Clarke 2009). Data on estimates of TFA intake show a wide variation worldwide, from 0.1–0.6 g/day in Korea and Japan, and 1.2–6.7 g/day among Western European men (Craig-Schmidt 2006), to 2–4 g/day in North America (Skeaff 2009), 2.6, 4.5 and 7.2 g/day in Costa Rica, Chile and Argentina, respectively (Uicich *et al.* 2006; Valenzuela 2008), and 12.3 g/day in Iran (Mozaffarian *et al.* 2007). But, the degree of exposure to TFA in most countries is unknown. Populations in low- and middle-income countries could be disproportionately exposed to foods with high TFA content because of the use of partially hydrogenated oils and mix of shortenings and different oils in the elaboration of traditional dishes (Mozaffarian *et al.* 2007; Ghafoorunissa 2008; Butt and Sultan 2009) and local snacks and baked goods (Uicich *et al.* 2006; Baylin *et al.* 2007; Valenzuela 2008; Butt and Sultan 2009; Vieitez *et al.* 2011).

Voluntary industry efforts to reduce TFA intake have been slow and insufficient for the most part. In 2007, food industries in Latin America and the Caribbean (LAC) signed a PAHO/WHO declaration committing their support to a TFA-free Americas; a follow-up to their efforts in 2011 showed limited response and little progress (Monge-Rojas *et al.* 2011). Aside from the exceptional cases of the Netherlands and Argentina, where multisectorial collaboration between food industries and academia was the driving force behind the reduction in use of partially hydrogenated oils (Katan 2006; L'Abbe *et al.* 2009), evidence for other inter-sectorial collaborations is lacking. Most likely, the efforts to reduce TFA by the food industry in Finland, Norway and Costa Rica stemmed from spillover effects of regulation in neighbouring countries or trade partners (Colon-Ramos *et al.* 2007; L'Abbe *et al.* 2009). Other voluntary industry efforts to eliminate industrial TFA content in the food supply

have also eventually capitulated government regulations (Katan 2006; Colon-Ramos *et al.* 2007; Tan 2009; Redelings *et al.* 2010).

In this article, we examine the efforts of government-initiated public health strategies in the LAC region to eliminate TFA in foodstuffs, as per PAHO/WHO recommendation. Specifically, we present the definitions used to describe TFA, strategies proposed to regulate TFA production and consumption and factors that enable and disable the process of regulation in the LAC region.

## Methods

Descriptive, prospective multiple case studies used in this study rigorously capture a series of phenomena in real-life context by allowing integration of various sources of information (answers to an open-ended questionnaire and review of internal documents and publicly available information) and cases as they become available (Yin 2009). This methodology is ideal to depict the most current data on the public health strategies followed by governments across the region.

### Study procedure

Data were obtained from open-ended questionnaires to 13 country representatives and from review of internal documents and of publicly available information. Between June 2010 and March 2011, country representatives from the health sector (ministries, departments and institutes of health) were purposively selected because they are knowledgeable of government-led public health strategies in their countries. Eleven of these country representatives had participated in the first PAHO/WHO *Trans-Fat Free Americas* task-force meeting in 2007 (PAHO 2007). The participating countries were: Argentina, Brazil, Colombia, Costa Rica, Chile, Guatemala, Mexico, Jamaica, Peru, Puerto Rico, Uruguay and Venezuela. Two other country representatives from the ministries of health in Ecuador and Colombia were recruited purposively through their participation at other TFA-related meetings.

An open-ended questionnaire was sent via electronic or regular mail to each representative (one per country). The questionnaires were written in their native languages (Spanish, Portuguese or English). Questionnaires were created based on formative research with representatives during the first PAHO/WHO's *Trans-Fat Free Americas* task-force meeting, and on consultation with previous work (Colon-Ramos *et al.* 2007). The questionnaire asked about: the country's definition of TFA, existence of regulation (current or in process), strategies for consumer education, analysis of TFA content in most popular processed foods consumed, whether the topic of TFA had been incorporated into any food or nutrition policy and an opinion about what were the challenges or enabling factors to progress in the reduction of TFA in foods in their countries.

In addition, representatives were asked to supply internal, non-sensitive documents to evidence their responses. Only one representative from each country was approached to participate and was asked to respond to the questions themselves or with help from colleagues. Therefore, there were no divergent responses from the same countries. All answers were verified for accuracy using the internal documents provided, as well as

a systematic search through publicly available information on the topic of TFA, particularly information from the ministries of health of each country. In certain cases, publicly available information was also used to complement the information obtained via the questionnaires. Questionnaires and the document search were completed between October 2010 and July 2012.

### Data analysis

The response rate for the questionnaire was 100%. Data obtained from the responses to the questionnaires and from the internal and publicly available document search were coded by common topics, as is standard in qualitative data analysis to provide more rigorous analysis in case studies (Yin 2009). The coding process was iterative, with the primary author identifying broad categories in definitions of TFA, government-led bans, labelling initiatives (both voluntary and mandatory), consumer and public health education strategies, as well as challenges and motivators to the feasibility of a regulation. A codebook with corresponding excerpts for each topic was created. The second author reviewed the codebook and all supporting documents; inconsistencies were discussed and resolved achieving over 95% agreement. Data are presented by these topics in tables, with direct references to publicly available information when appropriate.

## Results

Responses were obtained from all 13 countries queried and are summarized in Tables 1–4, along with publicly available information obtained from the Codex Alimentarius [WHO's and the Food and Agriculture Organization (FAO) of the United Nation's International Food Standards], the PAHO/WHO and Mercosur (the Southern Common Market agreement between Argentina, Brazil, Paraguay and Uruguay).

### TFA definitions

There were important inconsistencies in the way countries define TFA throughout the region (Table 1—for comparison purposes also includes the parameters of definitions used in Denmark and Canada). Puerto Rico defined TFA vaguely as any kind of hydrogenated fat, thereby including fully hydrogenated (containing only saturated fats) and partially hydrogenated (containing some unsaturated and saturated fats) in their definition. All other entities and countries specified that the parent molecule was an unsaturated fatty acid with a double bond in the *trans*-configuration, thereby differentiating them from the *cis*-unsaturated configuration of carbon double bond. Ecuador stated that TFA must be formed by partial extraction, processing or hydrogenation of vegetable oils, thus excluding any naturally occurring, ruminant-derived *trans* from its definition. Mexico, Peru, the Central American countries, the PAHO/WHO and Codex Alimentarius also specified that the double bond between the carbons had to be non-conjugated, thereby potentially excluding naturally occurring ruminant-derived *trans*, such as conjugated linoleic acid found naturally in milk and red meats, from their definitions. In contrast, Mercosur, Chile, Colombia and Jamaica do not make this exclusion

**Table 1** Specifications included in the definition of TFA used in the countries and entities interviewed

Entity/country	No specification	Unsaturated fatty acids	Double bond in <i>trans</i> -configuration	Double bond non-conjugated	Separated by at least one methylene (CH <sub>2</sub> ) group	Formed by partial extraction, processing or hydrogenation of vegetable oils
PAHO/WHO (PAHO 2007)	✓	✓	✓	✓		
Codex Alimentarius (Codex Alimentarius 2011)	✓	✓	✓	✓	✓	
Mercosur <sup>a</sup> (MERCOSUR 2003)	✓	✓	✓	✓	✓	
Central America <sup>b</sup> (Consejo de Ministros de Integración Económica 2011)	✓	✓	✓	✓	✓	
Colombia (Ministerio de la Protección Social de Colombia 2008)	✓	✓	✓	✓		
Chile (Ministerio de Salud de Chile 2009)	✓	✓	✓	✓		
Ecuador (Instituto Ecuatoriano de Normalización 2008)	✓	✓	✓	✓		✓
Jamaica (CARICOM 2010)	✓	✓	✓	✓		
Mexico (Secretaría de Economía de Mexico 2010)	✓	✓	✓	✓		
Peru (Ministerio de Salud de Peru 2012)	✓	✓	✓	✓	✓	
Puerto Rico (Senado de Puerto Rico 2007)	✓	✓	✓	✓	✓	
Canada (Health Canada 2009)		✓	✓	✓		
Denmark (Danish Veterinary and Food Administration 2003)		✓	✓	✓		

<sup>a</sup>Argentina, Brazil, Paraguay and Uruguay.<sup>b</sup>Guatemala, Honduras, El Salvador, Nicaragua and Costa Rica.

Denmark and Canada are included for comparison purposes (references are in parentheses).

because they do not specify that the double bonds must be non-conjugated. This way, these latter countries leave the definition open to the inclusion of naturally occurring *trans* together with industrially produced in their TFA definition.

### Existing regulations by country/entity

Table 2 presents the types of regulation by country or entity. Except for Mercosur countries and for Chile, most regulations were created after publication of WHO/PAHO recommendations to eliminate industrial TFA. Regulations were summarized and condensed into the following categories: (1) ban or limit of TFA content, (2) regulation with mandatory labels and (3) open or voluntary regulation. Together with Mercosur countries and Chile, who had regulations pre-dating the PAHO/WHO recommendation, Mexico, Peru and Puerto Rico all specified limits to TFA content in food products, but definition of limits varied considerably. For example, Puerto Rico did not specify a limit to TFA concentration, stating only that 'no food should contain hydrogenated fats [...] except foods that are directed to the sponsors in sealed packages of the original manufacturer' and that 'no trans foods will be served in schools, centers of daycare and homes for the elderly'. Somewhat similarly, Peru only limited TFA content in industrialized foods used for social feeding programmes, stating that these should have zero grams of TFA and be labelled as such. In contrast, the PAHO/WHO established that vegetable oils and spreadable margarine products should have <2% of industrially made TFA of the total fat content and <5% of total fat content for all other food products. Argentina and Chile coincided somewhat with PAHO/WHO's decree, with the following caveats: Argentina explicitly excludes all ruminant fats from any regulation, and Chile requests that all products have no more than 2% of industrially made TFA.

The definitions of TFA-free nutrient claims and labelling requirements varied considerably across entities (Table 2). The Codex Alimentarius and the countries of Central America, Colombia, Jamaica and Mexico did not circumscribe to limiting TFA concentrations or to mandatory labelling of TFA content. Only Ecuador and Mercosur specified the level of TFA concentration for products to make TFA-free claims, but these were not consistent (<0.5 g/serving and 1.5 g/100 g saturated fat or <0.1 g TFA/100 g, ml or serving, respectively). Peru only mentioned that TFA-free products should be labelled as such.

### Other public health strategies to reduce TFA consumption

Consumer education efforts were widely used by most countries since 2007, for the cases of Guatemala, Ecuador, Mexico, Costa Rica and earlier for Mercosur countries (Argentina, Brazil, Uruguay) and Chile (Table 3). 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 the national diets. This past year (2011–12), Costa Rica and Ecuador incorporated the TFA topic in a national policy, and Mexico produced a proposal to reduce to a minimum the TFA in foods, although the minimum TFA content permissible had not yet been defined at the time of publication.

**Table 2** Regulations for TFA by country/entity (references are in parentheses)

Countries/entities that ban or limit TFA	
PAHO/WHO (PAHO 2007)	<ul style="list-style-type: none"> <li>• TFA &lt;2% of total fat content in vegetable oils and spreadable margarines.</li> <li>• TFA &lt;5% of total fat content in all other products.</li> </ul>
Puerto Rico (Senado de Puerto Rico 2007)	<ul style="list-style-type: none"> <li>• No food that contains hydrogenated fats will be stored, distributed, used in preparation of any menu or served in any food establishment or mobile feeding units (except foods that are directed to the sponsors in sealed packages of the original manufacturer).</li> <li>• No <i>trans</i> foods will be served in schools, centres of daycare and homes for the elderly.</li> </ul>
Argentina (Secretaría de Políticas Regulación e Institutos and Secretaría de Agricultura Ganadería y Pesca de Argentina 2010)	<ul style="list-style-type: none"> <li>• Industrially made TFA (iTFA) &lt;2% of total fat content in vegetable oils and spreadable margarines.</li> <li>• iTFA &lt;5% of total fat content in all other products.</li> <li>• These regulations explicitly exclude all fats from ruminants.</li> </ul>
Brazil (Comissão de Desenvolvimento Econômico Indústria e Comércio 2007)	<ul style="list-style-type: none"> <li>• Prohibits the production of 'primary food source that originates from the process of hydrogenation of vegetable oil, transforming it to hydrogenated fat, known as trans fats'.</li> </ul>
Chile (Ministerio de Salud de Chile 2009)	<ul style="list-style-type: none"> <li>• iTFA &lt;2% of total fat content in all products.</li> </ul>
Peru (Ministerio de Salud de Peru 2012)	'All industrialized foods destined for social feeding programs should have "0g" of trans fats and be labeled as such'.
Mexico (Secretaría de Economía de Mexico 2010)	Recommendation to limit the maximum permitted level of TFA consumption.
Countries/entities with mandatory label	
Mercosur (MERCOSUR 2012)	TFA-free products: <1.5 g of saturated fat and $\leq 0.1$ g TFA per 100 g or 100 ml. For dishes prepared or by portion >30 g or 30 ml. If portions are less than or equal to 30 g or 30 ml, value will be calculated based on 50 g or 50 ml.
Brazil (ANVISA 2003)	Mandatory label in fast foods and restaurants proposed.
Peru (Ministerio de Salud de Peru 2012)	Mandatory label proposed: TFA should be declared in labelling as 'trans fats' in grams per serving in whole numbers and decimals. If the product is <i>trans</i> free, just omit mention or declare 0 g or declare 'free of trans'.
Ecuador (Instituto Ecuatoriano de Normalización 2008)	TFA-free products: <0.5 g/serving. TFA content must be declare as the closest number to 3 g; and in increments of 0.5 g for contents <3 g.
Chile (Ministerio de Salud de Chile 2009)	Those foods with $\leq 3$ g/serving of total fat in their usual consumption must declare MUFA, PUFA, saturated fats, cholesterol and TFA
Puerto Rico (Senado de Puerto Rico 2007)	Follows US FDA mandatory labelling of TFA content in foods containing $\geq 0.5$ g/ serving, and products make nutritional claims about fats or cholesterol.
Countries/entities with voluntary regulation	
Codex Alimentarius (Codex Alimentarius 2011)	Leaves it open for national legislation to decide whether or not to declare TFA.
Central América (Consejo de Ministros de Integración Económica 2011)	Declaration is voluntary as long as product does claim nutritional qualities.
Colombia (Ministerio de la Protección Social de Colombia 2008)	Declaration is voluntary as long as product does not claim nutritional qualities.
Jamaica (CARICOM 2010)	If there's a declaration with respect to the type of fatty acid or cholesterol, then quantity of saturated fats, cholesterol, PUFA and TFA should be declared.
Mexico (Secretaría de Economía de Mexico 2010)	<p>If there's a declaration with respect to the type of fatty acid or quantity of cholesterol:</p> <p>TFA (per 100 g/100 ml or per serving) should then be declared together with the MUFA and PUFA (g) and cholesterol (mg) quantities.</p> <p>TFA-free definition is not specified.</p>

**Table 3** Public health strategies to reduce TFA by country (results from surveys to country representatives and from document research. References are in parentheses)

Consumer education efforts	
Argentina	<ul style="list-style-type: none"> <li>• Communication campaign in the province of La Pampa to reduce sodium and TFA content in bakery goods and in foods prepared in restaurants and in other outlets.</li> <li>• Inclusion of TFA information in the nutritional guidelines for the Argentinian population (Ministerio de Salud Pública de Uruguay 2005a).</li> </ul>
Brazil	<ul style="list-style-type: none"> <li>• Inclusion of TFA information in the nutritional guidelines for the Brazilian population (Ministério da Saúde de Brazil 2008).</li> <li>• Development of consumer educational materials regarding TFA content in foods (ANVISA 2008).</li> <li>• Inclusion of TFA information in educational material for the National Mobilization for the Promotion of Health and Quality of Life Day.</li> <li>• Inclusion of TFA information in the 'More Health' Federal government programme.</li> </ul>
Chile	<ul style="list-style-type: none"> <li>• Inclusion of TFA information in nutritional guidelines for Chilean population (Ministerio de Salud de Chile 2005).</li> <li>• Inclusion of TFA information in the national campaign 'Choose to Live Healthy' (Gobierno de Chile 2011).</li> <li>• Inclusion of TFA information in consumer educational materials to adopt a healthy lifestyle (Instituto de Nutrición y Tecnología de Alimentos <i>et al.</i> 2005).</li> <li>• Industry-led campaigns to educate consumers to choose TFA-free margarines, bakery products, sweets, French fries and other foodstuffs.</li> </ul>
Costa Rica	<ul style="list-style-type: none"> <li>• Inclusion of TFA information in nutritional guidelines for Costa Rican population (CIGA 2010).</li> <li>• Intersectoral workshops imparted by INCIENSA (Costa Rican Institute for Investigation and Education in Nutrition and Health) to educate professionals in the health sector, food industry and academia about TFA health consequences.</li> <li>• Intersectoral workshops imparted by INCIENSA to define strategies to educate consumer.</li> <li>• Mass-media health prevention messages about TFA content in frequently consumed foods in Costa Rican population.</li> </ul>
Guatemala	<ul style="list-style-type: none"> <li>• National training imparted by the Consumer League of Guatemala and with support of Institute of Nutrition of Central America and Panama (INCAP).</li> <li>• Inclusion of TFA topic in the work plan of the National Intersectoral Commission for Chronic Disease Prevention in Guatemala.</li> <li>• National and regional workshops to educate food industry, health and economic sectors, as well as consumer associations, about strategies to reduce TFA consumption.</li> </ul>
Ecuador	Proposal for a programme to improve the profile of fatty acids in oils, margarines, processed foods and foods originating in transnational and local fast food restaurants.
Mexico	<ul style="list-style-type: none"> <li>• Promotion and education for healthy eating (Secretaría de Salud de Mexico 2006).</li> <li>• Orientation and recommendations for consumers to choose low-TFA foods (Secretaría de Salud de Mexico 2008).</li> </ul>
Uruguay	<ul style="list-style-type: none"> <li>• Elaboration of a manual for promotion of healthy practices for the Uruguayan population (Ministerio de Salud Pública de Uruguay 2005b).</li> <li>• Inclusion of TFA information in educational materials for the consumer and nutritional guidelines for the Uruguayan population (Ministerio de Salud Pública de Uruguay 2005a).</li> </ul>
Venezuela	Education about TFA in the diet to professionals and general public.
Food composition tables with analysis of TFA content	
Argentina	<ul style="list-style-type: none"> <li>• Analysis of TFA content in some foods in Argentina (Uicich <i>et al.</i> 2006).</li> <li>• Inclusion of TFA determination in FAO Project's 'Development of database and food composition tables for Argentina, Chile and Paraguay to strengthen international commerce and consumer protection' (Ministerio de Agricultura Ganadería y Pesca de Argentina).</li> </ul>
Brazil	<ul style="list-style-type: none"> <li>• Elaboration of Brazilian food composition table with information regarding fatty acid profiles, including TFA (Núcleo de Estudos e Pesquisas em Alimentação—Universidade Estadual de Campinas 2004).</li> </ul>
Chile	<ul style="list-style-type: none"> <li>• Inclusion of TFA determination in FAO project 'Development of database and food composition tables for Argentina, Chile and Paraguay to strengthen international commerce and consumer protection' (Ministerio de Agricultura Ganadería y Pesca de Argentina).</li> </ul>
Colombia	<ul style="list-style-type: none"> <li>• Analysis of TFA content in margarines used as spreads and for cooking.</li> <li>• Fatty acid composition of cooking fats in Bogotá, Colombia (Baylin <i>et al.</i> 2009).</li> </ul>
Costa Rica	<ul style="list-style-type: none"> <li>• Elaboration of food composition table including fatty acid profiles in 220 foods in the typical diet of Costa Ricans (Monge-Rojas and Campos 2006; Baylin <i>et al.</i> 2007).</li> </ul>
Ecuador	<ul style="list-style-type: none"> <li>• Ongoing analysis of TFA content on some processed foods (Lopez 2010).</li> </ul>
Mexico	<ul style="list-style-type: none"> <li>• Food composition table for foods frequently consumed in the Mexican diet, includes fatty acid profile for 261 foods of usual consumption in Mexico (Villalpando <i>et al.</i> 2007).</li> </ul>
Venezuela	<ul style="list-style-type: none"> <li>• Ongoing analysis of TFA content in some foods frequently consumed in Venezuela (Bosch 2009).</li> </ul>
Uruguay	<ul style="list-style-type: none"> <li>• Analysis of TFA content in some foods of frequent consumption by the Uruguayan population (Grompone 2010; Vieitez <i>et al.</i> 2011).</li> </ul>

(continued)

**Table 3** Continued

Analysis of TFA intake in usual diet

Mexico	<ul style="list-style-type: none"> <li>• Determination of TFA intake in Mexican adolescents and adults (Ramirez-Silva <i>et al.</i> 2011).</li> </ul>
Costa Rica	<ul style="list-style-type: none"> <li>• Determination of fatty acid intake in Costa Rican adolescents (Monge-Rojas <i>et al.</i> 2005).</li> </ul>
Chile	<ul style="list-style-type: none"> <li>• Determination of TFA intake in Chilean subpopulations (Zamorano <i>et al.</i> 2010).</li> </ul>
Argentina	<ul style="list-style-type: none"> <li>• Analysis of TFA intake among adults and adolescents in Argentina (Peterson <i>et al.</i> 2004; Uicich <i>et al.</i> 2006).</li> </ul>
Brazil	<ul style="list-style-type: none"> <li>• Analysis of TFA intake in the city of Sao Paolo (Castro <i>et al.</i> 2009).</li> </ul>

National recommendations or guidance

Mexico	<ul style="list-style-type: none"> <li>• Recommendation to reduce to a minimum the TFA in the National Agreement for Healthy Eating: strategy for overweight and obesity 2010 (Secretaría de Salud de Mexico 2006; Secretaría de Salud de Mexico 2010).</li> </ul>
Ecuador	<ul style="list-style-type: none"> <li>• Incorporation of TFA information in policies for healthy lifestyle and in the National Nutrition Strategy 2011.</li> </ul>
Costa Rica	<ul style="list-style-type: none"> <li>• Incorporation of TFA topic in National Food Security and Nutrition Policy 2011–12. (Ministerio de Salud de Costa Rica 2011)</li> </ul>
Brazil	<ul style="list-style-type: none"> <li>• Incorporation of TFA in national policies of food and national policies for health promotion.</li> <li>• Regulation regarding the promotion of commercial foods with high content of sugars, saturated fats and TFA (ANVISA 2010).</li> </ul>
Chile	<ul style="list-style-type: none"> <li>• Global strategy against obesity: co-ordinates multisectorial initiatives to prevent obesity and promote healthy food and physical activity.</li> <li>• Modification of Chilean code of advertisement ethics about publicity in foods and drinks directed to children, for food industry efforts to line with the promotion of healthy lifestyles (Ministerio de Economía Fomento y Turismo de Chile 2007; Ministerio de Salud de Chile).</li> </ul>

MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.

### Factors that affected feasibility of regulation

Country representatives were asked about which factors, in their opinion, influenced the feasibility of a regulation to reduce TFA in their countries. Most countries coincided on two factors: (1) knowing the TFA content of foods and diets in their countries and (2) intersectoral collaboration with the industry (Table 4).

Costa Rica and Mexico, countries that have existing data on TFA content in foods and diets, stated that this was an enabling factor for regulation. To illustrate: '... since the 2007 analysis of the fatty acids in foods, now we have identified some products that specify content of TFA in their nutrition labels, and even others that label their product as trans-free' (representative from Mexico) (although Mexico does not yet have a definition for 'trans-free' claims). Representatives from Chile, Colombia, Ecuador, Guatemala, Venezuela and Jamaica felt that the lack of a food composition table was a challenge: 'Lack of scientific evidence about the TFA content of foods frequently consumed by the Guatemalan population that would inform [...] regulatory norms and laws' (representative from Guatemala) and 'Lack of studies on the levels of TFA in local foods limits the ability to track progress in reduction and elimination of TFA in foods' (representative from Jamaica).

Intersectoral collaboration between regulatory agencies and the food industry, and co-operation and co-ordination with and within the food industry, were key enablers mentioned by Brazil, Argentina, Chile, Costa Rica, Uruguay, Ecuador, Colombia and Venezuela. For example, due to intersectoral collaboration and work with the Chilean food industry, Chile's public health goal (<2% TFA) could be achieved within 2 years because they were assured that the industry had the necessary technology to achieve this goal in a timely fashion:

'... moreover, [intersectoral] participation had an educational effect in the production sector, stimulating this way the [Chilean food] industries to speed up the term given and jumpstart the elaboration of healthier foods'. Argentinian representatives also mentioned that the food industry had been working with small and medium food producers and this enabled feasibility of regulation in their country. Uruguay, Ecuador and Brazil representatives indicated that intersectoral collaboration across government ministries provided further support to a regulation.

Other factors mentioned included: mandatory labelling of TFA, seen as an enabler that produced intersectoral collaboration and motivated the food industry to reduce TFA content in foods; consumer education and awareness, thought to have influenced manufacturers to reduce use of TFA in foods, or else mentioned as a barrier if consumers did not play a role because of lack of awareness; lack of monitoring and surveillance, posed a challenge to the implementation of any regulation because it hinders the ability to know whether the food industry is complying with the regulations. At least three countries also coincided in that there were technological challenges for the smaller industries to reduce TFA from their products, because they lacked resources, knowledge or support to do this, and that international visibility of the topic of TFA enabled a regulation.

### Discussion

The WHO has deemed that there is enough evidence to recommend a very low intake of TFA, that is, <1% of total energy intake (Nishida and Uauy 2009), and in 2007, the PAHO/WHO called for the elimination of industrially produced TFA from the food supply in the Americas (PAHO 2007). Our

**Table 4** Critical factors that influence feasibility of regulation (mentioned by at least three countries)

Country	TFA content in foods and diet	Intersectoral collaboration	Mandatory labelling	Consumer awareness	Monitoring and surveillance	Technological challenges, reaching small industry	National and international visibility
Argentina		Enabler	Enabler	Enabler		Challenge	
Brazil		Enabler	Enabler			Challenge	
Chile	Challenge	Enabler	Enabler		Challenge		
Colombia	Challenge	Enabler	Enabler	Challenge			
Costa Rica	Enabler	Enabler			Challenge	Challenge	Enabler
Ecuador	Challenge	Enabler	Enabler		Challenge		
Guatemala	Challenge						
Jamaica	Challenge			Enabler/challenge			Enabler
Mexico	Enabler				Challenge		
Uruguay		Enabler	Enabler	Enabler	Challenge		Enabler
Venezuela	Challenge	Enabler				Challenge	
Peru				Challenge			Enabler
Puerto Rico				Enabler	Challenge		

results present evidence that low- and middle-income countries in the LAC region have been moving towards elimination of industrially produced TFA, as per WHO's recommendation, even before 2007; however, overall efforts are not co-ordinated. Evidence for this include: (1) a lack of a uniform definition of TFA across the regions, leading to: (2) differing, and sometimes contradictory, regulations for *trans*-free claims and nutrition labelling and (3) variation in public health strategies to reduce TFA intake. Countries identified that challenges to the implementation of policies to reduce TFA include: the shortage of information on TFA content of diets and foods, consumer unawareness of TFA and lack of monitoring and surveillance. The identified enabling factors were: intersectoral collaboration with industry, mandatory labelling regulation and international and national visibility of the topic, which facilitated reduction of TFA content. Following WHO's recommendation for virtual elimination of TFA in the region, and monitoring and surveillance of this elimination, will require a co-ordinated effort across countries.

#### Lack of standard TFA definition hampers regulation

The lack of a uniform definition of TFA in the region impedes a co-ordinated effort to their elimination. In the region, some countries include up to five levels of detail in their TFA definition (the parent molecule is an unsaturated fatty acids that has a *trans*-configuration in the non-conjugated double carbon bond, interrupted by a methylene group), whereas others leave the interpretation open to include naturally occurring *trans* in ruminant fats. Not having a standardized definition across countries impedes a co-ordinated strategy across governments to establish a maximum consumption limit and nutritional labelling requirements (along with standards for nutrient claims) that are comprehensible to consumers and policymakers across the region.

Better understanding how the definitions evolved throughout the region may be helpful to better contextualize how to move forward. As per review of events, it is evident that the heterogeneity in the definitions evolved through three key

developments: (1) first, the heightened global awareness about the risk for cardiovascular diseases associated with high consumption of TFA (World Health Organization 2003) and the consequent establishment of TFA definitions and/or of the concept 'trans-fat free' in the nutritional labelling of processed foods in Denmark, Canada, the US Food and Drug Administration (FDA), Codex Alimentarius and Mercosur countries during the period of 2003–06 (PAHO 2007). At this point, Costa Rica and Brazil emerged as early adopters, but following different models: Costa Rica combined the definition of TFA established by Codex Alimentarius and the TFA limits defined by the FDA, and Brazil adopted the limits established by Canada (Martins *et al.* 2012). (2) The second development was the establishment of the 2007 PAHO/WHO *Trans*-free Americas Task Force, which recommended a regional adoption of the definition established by Codex Alimentarius, and limits of TFA content similar to those established by Canada (PAHO 2007). Following suit, some countries modified their definitions and adopted the recommendation by PAHO (the case of Chile and Argentina). However, other countries adopted the limits proposed by the FDA, since they had already achieved an intersectoral consensus with the local food industry (e.g. the cases of Central American countries, Colombia, Ecuador and Mexico). (3) Finally, a third development that contributed to the heterogeneity in definitions is the acknowledgement that the epidemiological evidence regarding *trans*-fats of animal origin was different from that of industrially produced *trans*-fats (Nishida and Uauy 2009; Teegala *et al.* 2009). This promoted the discussion that these fats should be excluded from the total TFA calculation, and some countries in the region, such as Argentina, included this topic as part of their new definition.

To date there is no standard regional definition for TFA that is congruent with the public health strategies proposed. For instance, in the cases of Argentina and Chile, even though ruminant animal sources and partially hydrogenated sources are included in the TFA definition, the regulations (label and maximum limit) exclude any ruminant TFA. Not only is this not congruent with the definition but it also poses a serious



problem for the quantification of total TFA in products elaborated from a mixture of ingredients of industrial and animal origin. For example, it will be impossible to distinguish which is the source of *trans* 18:1 vaccenic and elaidic acids because both are found in ruminants and produced via partial hydrogenation of oils (Stender *et al.* 2008) and up to this date, there is no methodology that allows for differentiation of the origin of these *trans*. Elaidic acid intake, which is found in high proportions in partially hydrogenated oils, has detrimental health effects (Mozaffarian *et al.* 2009). This incongruence poses a difficulty in complying with the established definition in Argentina and Chile.

### Deciding on the best strategy for public health

Governments of Denmark, Iceland, Sweden, Austria, Switzerland and New York have banned TFA from foodstuffs as a public health measure (Leth *et al.* 2006; Angell *et al.* 2009; Coombes 2011). In Denmark, this has been done without affecting taste, price or availability of foods (Leth *et al.* 2006). Evidently, with the appropriate compliance from industry, these regulations will yield lower TFA content in products (Leth *et al.* 2006; Angell *et al.* 2009, 2012; Skeaff 2009) and although the effects on coronary heart disease in New York are yet to be studied, the ban on TFA is thought to have played some part in a decrease in coronary heart disease mortality in Denmark (L'Abbe *et al.* 2009).

Industry-led initiatives alone will not lead to elimination of industrial TFA without intersectoral collaboration with academia and government or without consumer awareness (Skeaff 2009; Monge-Rojas *et al.* 2011). In Costa Rica, the main producer of partially hydrogenated vegetable oils voluntarily reduced TFA content of their products as a consequence of the 2006 nutrition labelling regulations in the USA, a key importer of their products (Colon-Ramos *et al.* 2007). In Argentina, the academic sector worked closely with one of the main vegetable oil manufacturers to improve the fatty acid profile in their products (L'Abbe *et al.* 2009). In Europe, the Netherlands witnessed voluntary reduction of TFA led by one multinational corporation and likely instigated by consumer awareness and media visibility (Katan 2006; Korver and Katan 2006).

Successful intersectoral collaborations between academia, government and the food industry have been documented in two contexts: (1) the first one is where industry initiates voluntary reduction of TFA before any government conversation, most likely in view of regulatory changes to come (the case of Costa Rica, Argentina and the Netherlands) and (2) the second stems from discussions originating at the global arena, for example, those conversations that started after the recommendations of the 2007 *Trans-free Americas* Task Force, that force a discussion on public health concerns, and that wishes to engage the industry and other sectors into the conversation (Colon-Ramos *et al.* 2007; Perez-Ferrer *et al.* 2010). The second kind of intersectoral collaborations can be helpful for updates on regulation that will incentivize the industry to reduce TFA content and for transfer of technology information across countries and within the various TFA production sectors (the case of Chile, Colombia, Venezuela and Brazil).

Country representatives mentioned that not having information on TFA content of foods and diets impeded regulation.

Intersectoral collaboration with the food industry and academia will be needed to access the necessary technology to assess fatty acid profiles (Valenzuela 2008). As evidenced by the existence of food composition tables and scattered studies across the region, very little is known about the TFA content of diets. Determining the presence of TFA in the main sources of vegetable fat is a possibility to moving forward with the development and implementation of public health strategies. A recent study in Bogota, Colombia, has shown that vegetable oils, primarily sunflower oils, were the primary home cooking fats and had unexpectedly high TFA content (Baylin *et al.* 2009). An ongoing multicentre study is currently taking random samples of commercially available oils and fats commonly consumed in the major cities of four countries in the region (Argentina, Brazil, Mexico and Costa Rica) (Monge-Rojas *et al.* 2010). Unfortunately, because of lack of economic resources and commitment of changing political parties, it has been difficult to secure participation of other countries (personal communication with study principal investigator [PI]).

New methodology that facilitates TFA analysis in diet by the use of whole blood 'spots', could also be done in a relatively small number of subjects to complement the analysis of TFA of the food supply screening (Armstrong *et al.* 2008; Fratesi *et al.* 2009). The feasibility and impact of this needs to be determined. Mandatory nutrition labelling could also be a useful tool to promote intersectoral collaboration, as mentioned by the country representatives interviewed. Nutrition labelling has led to higher consumer awareness in Canada and in the USA, and to lower TFA intake and biomarkers in Canada (Clifton *et al.* 2004; Friesen and Innis 2006; Angell *et al.* 2009). Educating the consumer through public health campaigns may incentivize manufacturers to reconfigure products, as has happened elsewhere (Leth *et al.* 2006; Angell *et al.* 2009; Ratnayake *et al.* 2009).

A major challenge that still stands is the establishment of monitoring and surveillance systems to ensure that industries abide by regulations. In Uruguay, despite regulation that all 'Zero *trans*' products must contain <0.2 g/serving (Grompone 2010), a random sample of cookies labelled as 'Zero *trans* fats' showed to have more than 1 g of TFA per serving. To our knowledge, none of the countries surveyed for this study had a monitoring and surveillance system in place, although some (Argentina, Mexico, Brazil and Costa Rica) are part of a multicentre study that will survey TFA content of most-frequently consumed manufactured foods (Monge-Rojas *et al.* 2010). Perhaps this will shed light about the feasibility of a co-ordinated monitoring and surveillance system across the region.

The efforts of Latin American countries to virtually eliminate TFA from foodstuffs have involved legal, educational or academic (research) mechanisms. However, the approach in the plurality of countries in the region does not involve all mechanisms and different sectors, in a systematic, co-ordinated approach to eliminate industrial TFA. Best practices across the region include: standardization of a single definition of TFA and TFA free nutrient claims across the region, such as PAHO/WHO's, to have congruent standards; a clearly identified ban of TFA in products; mandatory declaration of TFA content in nutritional labelling of prepackaged foods, restaurants and other points of purchase; a comprehensive food composition

table and academic studies on usual TFA intake to monitor the content of TFA in commonly consumed foods and in the diets of the population through small number screening using whole blood spots; and thorough consumer education and involvement of TFA reduction/consumption guidelines in national health strategies and policies.

It is unlikely that countries will adopt these best practices at once. While consensus in the process to define TFA, and standardization of a definition and appropriate strategies are reached, it will be important to start raising awareness of the problem in individual countries. We propose to start by identifying countries with highest exposure to TFA through the approach used by the regional multicentre study by randomly sampling fat sources that are commonly used. This activity could be facilitated by intersectoral collaboration between academics and the food industry as mentioned above. In addition, small surveys ( $n=100$ ) to assess blood TFA levels using blood spots could be conducted to group countries into risk level by exposure. Most likely, these two strategies combined will raise consumer awareness and intersectoral collaborations.

## Conclusion

Despite WHO deeming enough evidence to recommend virtual elimination, and the guidance offered by the PAHO/WHO's *Trans-Fat Free Americas* task force to eliminate industrially produced TFA from the food supply, countries have been unable to adopt a common definition, which impedes a co-ordinated strategy to significantly reduce TFA via mandatory labelling, maximum permissible consumption, nutrient claims and the establishment of monitoring and surveillance systems. The first step to establish a co-ordinated intersectoral strategy to facilitate communication about TFA content in foods that could lead to regulation, consumer education and a systematic monitoring and surveillance system is to reach consensus on a uniform definition for TFA. Simultaneously, countries need to determine their level of exposure to TFA through the implementation of small surveys to assess blood TFA levels using blood spots, and the evaluation of TFA in fat sources that are commonly used.

## Authors contributions

All authors contributed to the data analysis, interpretation and revisions of the manuscript drafts. Specifically, U.C.-R. led the data analysis, drafted the manuscript and led revisions of the manuscript; R.M.-R. designed the data collection instruments, collected the information, contributed to data analysis and interpretation and to the revisions of the drafted manuscripts; H.C. contributed importantly to the interpretation of data analysis and reviewed all drafts and final manuscript.

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## Conflict of interest

None declared.

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