



**A trans European Union difference in the decline in trans fatty acids in popular foods - a market basket investigation.**

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## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses

Continued on next page

**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

**Discussion**

Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results

**Other information**

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

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7 2 **A trans European Union difference in the decline in *trans* fatty acids in**  
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10 3 **popular foods - a market basket investigation.**

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## 22 9 **Article summary**

### 23 24 10 **Article focus**

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26 11 Are popular foods with high amounts of industrial trans fatty acids still available in EU-countries to the same  
27 12 extent as it was in 2006

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29 13 Is there a difference in availability of such foods between Western and Eastern EU-countries  
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### 35 15 **Key messages**

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37 16 Industrial trans fatty acids in popular foods in Western EU-countries have declined considerably since 2005. In

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39 17 Eastern Europe industrial trans fatty acids in popular foods are in spite of some decline still high

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41 18 A low average intake of industrial trans fatty acids at the population level does not preclude a high intake among  
42 19 subgroups

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44 20 Most EU countries rely on food producers to voluntarily reduce the amounts of industrial trans fatty acids in

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46 21 foods with variable results. An effective alternative is legislation so far only used by a few EU-countries  
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### 52 23 **Strengths and limitations**

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4 1 A strength is the measurement of trans fatty acids in many popular foods in several EU-countries in 2005 and  
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6 2 again in 2009  
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8 3 A limitation is that the average daily intake of trans fatty acids was not measured in subgroups of the population,  
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10 4 but instead inferred from the popularity of fast food and from the presence of popular foods with high amounts  
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12 5 of industrial trans fatty acids in large supermarkets  
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## 7 **ABSTRACT**

8 **Objectives:** To minimize the intake of industrial trans fatty acids (I-TFA) some countries have introduced  
9  
10 labelling, while others have introduced legislative limits on the content of I-TFA in food. However, most  
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12 countries still rely on food producers to voluntarily reduce the I-TFA content in food. The objective of the  
13  
14 present study was to investigate the efficiency of these strategies in the EU.  
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17 **Design:** The potential consumption of I-TFA was assessed in a market basket investigation by analysing the I-  
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19 TFA content in popular foods.  
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22 **Setting:** A standardized purchase methodology was used in 16 EU countries in 2005 and again in 2009 .  
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25 **Samples:** 70 servings of French fries and chicken nuggets, 90 packages of microwave popcorn, and 442 samples  
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27 of biscuits/cakes/wafers with “partially hydrogenated vegetable fat” listed high on the list of ingredients were  
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29 analysed. A high-trans menu was defined as a large serving of French fries and nuggets, 100 g of microwave  
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31 popcorn, and 100 g of biscuits/wafers/cakes.  
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34 **Results:** In 2005, a high-trans menu provided above 30 g of I-TFA in five EU countries in Eastern Europe and  
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36 20–30 g in eight EU countries in Western Europe. In 2009 the values in Hungary, Poland, and the Czech  
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38 Republic remained high between 10 and 20 g, whereas they were less than 2 g in Germany, France and the UK.  
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41 **Conclusion:** In 2009 contents of I-TFA in popular foods in Western Europe appear low but, in spite of some  
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43 reduction, still high in Eastern European EU countries. These findings suggest that millions of people in the EU  
44  
45 still consume I-TFA in amounts that substantially increase their risk of coronary heart disease.  
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## 1 INTRODUCTION

2 *Trans* fatty acids (TFA) in food originate from industrial hydrogenation of oils and from ruminant  
3 sources. Compared to unhydrogenated oils, fats containing industrial *trans* fatty acids (I-TFA) are  
4 solid at room temperature, have some technical advantages in food processing, and prolong the shelf  
5 life of food. However I-TFA can constitute up to 60% of the fats in certain foods, whereas ruminant fat  
6 contains at most 6% TFA.[1] A meta-analysis of four large prospective studies found that an intake of  
7 TFA corresponding to 2% of the total energy intake (E %) (approximately 5 g/d) was associated with a  
8 23% increase in the risk of coronary heart disease[2]. Several public health organisations have  
9 recommended that I-TFA intake should be lowered as much as possible[3-5]. In 1976, the average  
10 intake of TFA in Western Europe was 6 g/d. In 1996, this intake had dropped to 2.6 g/d (range 1.2 to  
11 6.7 g/d), corresponding to 0.5–2.1 E% [6]. Approximately half of this intake was from ruminant TFA  
12 and only about 1.3 g was from I-TFA, which constitutes a 78% decrease since 1976[6]. Despite a mean  
13 population intake of approximately 1 g of I-TFA per day in Denmark in 2001, it was still possible to  
14 consume 20–30 g of I-TFA in a single high-*trans* menu by eating popular food products such as wafers,  
15 microwave popcorn, nuggets, and French fries[5]. Among the 5 million Danes, 10,000–50,000 people  
16 consumed food from this type of menu several times each week, and got a daily intake of more than 5 g  
17 I-TFA[4]. Generalizing to the population in the EU, this corresponds to 1-5 million people.

18  
19 In 2003, Canada introduced the mandatory labelling of the I-TFA content in pre-packaged food. In the  
20 same year, Denmark introduced a legislative limit of 2% I-TFA in fat used for foods. The European  
21 Commission initially opposed this legislation but in March 2007 dropped its infringement proceedings  
22 against Denmark because of increased scientific evidence on the dangers of *trans* fats[7]. The US  
23 introduced mandatory labelling of pre-packaged food in 2006, followed by legislative limits on I-TFA



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4 1 in the food served in restaurants in New York City in 2008 and in 2010-11 in the state of California. In  
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6 2 2009, Austria and Switzerland introduced a legislative ban similar to the Danish' to be followed in  
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8 3 2011 by Iceland and Sweden. Of the EU's approximately 500 million inhabitants who consume food  
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10 4 that still may contain high amounts of *trans* fat, Denmark's and Austria's populations, representing  
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12 5 approximately 14 million people, are the exceptions.

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16 6 In 2005, we assessed by a market basket investigation the availability of a high-*trans* menu (large  
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18 7 servings of French fries and nuggets, 100 g of microwave popcorn and 100 g of biscuits/wafers/cakes)  
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20 8 in 15 EU countries, and found that, in spite of a low mean intake, high concentrations of I-TFA were  
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22 9 still present in many popular foods. Thus, subgroups of the populations could have an intake that is  
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24 10 considerably higher than the recommended upper limit for intake of I-TFA[8]. I-TFA in foods from  
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26 11 international fast food providers was an important contributor to the high intake in these sub-  
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28 12 populations[9]. Still in 2009, EU countries (with the exception of Austria and Denmark) rely on food  
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30 13 producers to voluntarily reduce the amounts of I-TFA in foods. The present study assess the efficiency  
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32 14 of that strategy in three Eastern European countries, Hungary, Poland, and the Czech Republic, and in  
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34 15 three Western European countries, Germany, France, and the UK.  
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## 42 17 **METHODS**

### 43 18 **Purchase of food products**

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45 19 Between November 2004 and January 2006, 542 items of foods were purchased in 26 countries. The  
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47 20 cities included were partly determined by visits taken by the authors and their colleagues for other  
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49 21 purposes, and these visits were supplemented by arranged visits by two of the authors (SS, JD). The  
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51 22 tourist office in the city was asked to identify three large supermarkets in the vicinity, preferably chain  
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4 1 supermarkets with many large shops in the capital and across the country. A written procedure was  
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6 2 followed that included details about which products to select and instructions for storage methods until  
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8 3 the food could be returned to the laboratory. Fast food items (chicken nuggets and French fries) were  
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10 4 obtained from McDonald's and KFC outlets. Microwave oven popcorn and biscuits/cakes/wafers were  
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12 5 bought if "partially hydrogenated fat" or a similar term was listed among the first three ingredients and  
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14 6 if the food label indicated that the fat content exceeded 15 g of fat per 100 g.  
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18 7 In July 2009 to September 2009, the capitals of Poland, the Czech Republic, Hungary, Germany,  
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20 8 France, and the UK were revisited and the same procedures for the purchase of food items were  
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22 9 followed. If possible, the same stores were revisited and the same brands were bought. Altogether, 602  
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24 10 samples of food in EU countries were purchased  
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### 29 12 **Analysis for TFA**

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32 13 The microwave popcorn was popped before processing. The foods were homogenised, and the fatty  
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34 14 acid content was analysed by gas chromatography (GC) on a 100-m highly polar capillary column.  
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37 15 Thin layer chromatography on silver nitrate-impregnated silica with renewed GC verified the  
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39 16 results[10]. The method is accredited by the Danish Accreditation Authorities (DANAK) according to  
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41 17 ISO 17025.  
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### 45 19 **Calculation**

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48 20 For comparison, the amounts of I-TFA in the French fries and the chicken nuggets were expressed as  
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50 21 the amounts in a serving size equivalent to a large serving from McDonald's in the US. The serving  
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52 22 sizes were 171 g of French fries and 160 g of chicken nuggets.  
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4 1 The potential consumption of I-TFA in a given country was defined as the sum of the I-TFA contents  
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6 2 provided by a high-*trans* menu that consisted of products with the highest identified amount of I-TFA.  
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## 9 3 **RESULTS**

### 10 4 **Biscuits, cakes, and wafers**

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14 5 Figure 1 presents data from the products bought in the six EU countries in 2005 and 2009. The  
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16 6 products are ranked according to I-TFA content and the combined values for the three Eastern EU  
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18 7 countries and for the three Western EU countries are given separately. The highest I-TFA contents (10–  
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20 8 15 g) in single 100 g servings in 2005 were found in Hungary, Poland, and the Czech Republic. In  
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22 9 France, Germany, and the UK, the I-TFA contents were lower but still considerable (4–7 g) averaging  
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24 10 5 g excluding one outlier.  
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28 11 In 2009 biscuits, cakes, and wafers in the three Eastern EU countries contained a smaller, but still  
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30 12 substantial, amount of I-TFA (4–8 g). In contrast, the I-TFA content in products in the three Western  
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32 13 EU countries was minimal (< 1 g). The same pattern was observed in each of the countries.  
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### 36 37 15 **Fast food**

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40 16 In 2005, the I-TFA content of the McDonald's servings in EU varied from less than 1 g in Copenhagen  
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42 17 to 7 g in London, UK. For KFC servings, there were even larger differences between the countries,  
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44 18 ranging from less than 1 g in Germany to 24 g in Hungary. 15 percent of the 54 fast food servings  
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46 19 contained more than 10 g per serving, and 50% contained between 5 and 10 g[9].  
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49  
50 20 In 2009, each of the 12 fast food menus, which were collected in France, Germany and the UK in the  
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52 21 same locations as in 2005, contained less than 1 g of I-TFA per serving (Figs. 2 and 3).  
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## 1 Popcorn

2 The highest I-TFA content in a single 100 g serving of microwave oven popcorn bought in each  
3 country is presented in the data given for the I-TFA content in the high-*trans* menu for that country  
4 (Fig. 2).

5 In 2009, the microwave oven popcorn samples with the highest amounts of I-TFA, which were from  
6 Hungary, Poland and the Czech Republic, contained the same amounts of I-TFA as the popcorn that we  
7 analysed in 2005. In contrast, the I-TFA in popcorn from Germany, France, and UK was negligible  
8 (Fig. 3).

## 9 A high-*trans* menu

10 In 2001, the potential consumption of I-TFA by eating a high-*trans* menu was 37 g in Denmark, but by  
11 2005, this potential consumption level was reduced to less than 1 g (Fig. 2). In 2005, by contrast, the  
12 potential consumption level via a high-*trans* menu exceeded 20 g in 13 out of the 16 EU-countries,  
13 from which foods were investigated. Hungary, the Czech Republic, and Poland ranked among the  
14 highest, with values around 40 g per menu. A considerable amount of the I-TFA in the menu was  
15 derived from the fast food meal.

16 Figure 3 demonstrates the time trends for I-TFA in the high-*trans* menu in Hungary, the Czech  
17 Republic, Poland, Germany, France, and the UK. In all of the countries, the contribution values  
18 obtained from McDonald's and KFC meals (nuggets and fries) in 2009 were negligible compared to the  
19 values obtained in 2005.

20 In 2009, biscuits, cakes, wafers, and microwave oven popcorn were still high in I-TFA in Eastern EU  
21 countries. In contrast, only small amounts of I-TFA in these same products obtained in Western EU  
22 countries were found.

## DISCUSSION

The data from 2005 show that, despite a mean daily intake of around 1 g I-TFA for the entire population (as it was in Denmark in 2001), it was still possible to consume 30-40 g I-TFA in a high-*trans* menu composed of popular foods. Consequently, a low average intake at the population level does not preclude a very high intake among some subgroups[6]. Following Denmark's 2003 legislation, the I-TFA content of the same menu was reduced to less than 1 g[9-10]. In addition, the data demonstrate that in 2005 it was possible to eat a menu of popular foods with more than 20 g of I-TFA in 13 out of 16 EU countries and up to 40 g in Hungary (Fig. 2). Thus far, EU countries (with the exception of Austria and Denmark) rely on food producers to voluntarily reduce the amounts of I-TFA in foods. The present study demonstrates the difference between Eastern and Western Europe in the efficiency of this strategy. The overall picture regarding the I-TFA content in fast food, biscuit/wafers/cookies and microwave oven popcorn in the EU indicates that I-TFA has disappeared from American-based fast food, such as that from McDonald's and KFC, mainly due to societal pressure[9,11]. The same decline for biscuits and snacks in Western EU countries were observed. In Eastern EU countries, however, the amount of I-TFA in these products is still high. We even observed this difference in products bought at the same retailers in the Eastern and Western EU countries (e.g. Carrefour).

### Limitations of the study

The average daily intake of I-TFA was not measured in subgroups of the population, but instead inferred from the popularity of fast food from McDonald's and KFC and from the presence of popular foods with high amounts of I-TFA in large supermarkets. The assumptions are: 1) the analysed brands

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1 of biscuits, cakes, wafers, and microwave oven popcorn were stocked at the supermarkets because they  
2 are sold in considerable amounts; 2) the majority of these foods are regularly bought and consumed by  
3 the same subgroups of consumers; and 3) the findings in the supermarkets in each capital are  
4 representative of the entire country and of adjacent countries in the Eastern and Western Europe.  
5 Another weakness is that only foods were bought in large supermarkets and from two international fast  
6 food providers (McDonald's and KFC). The I-TFA content in foods sold by small, privately owned  
7 shops or street vendors was not examined. Fats with high amounts of I-TFA prolong the shelf life of  
8 foods, and it is reasonable to assume that this factor is of even higher importance for small, privately  
9 owned shops than it is for larger supermarkets. The selective pattern of purchasing may thus have led to  
10 an underestimation of the amounts of I-TFA consumed by subgroups of the population.

## 12 **Implications**

13 An intake of above 5 g of TFA daily is associated with a health risk that can be eliminated more easily  
14 than many other diet-associated health risks. This issue is particularly relevant to low socioeconomic  
15 groups, such as truck and taxi drivers and manual labourers, who, due to other lifestyle factors, already  
16 have an increased risk of coronary heart disease partly due to high prevalence of smoking and poor  
17 diet, including high intake of I-TFA, and metabolic syndrome[12].

18 In 2011, EU countries, with the exception of Austria and Denmark, legally allow foods with the  
19 maximum concentration of I-TFA in the fat (i.e. 60%) to be sold without any notice as long as the food  
20 is unpackaged (as is the case for restaurants and fast food outlets). If the food is pre-packaged, then the  
21 law requires the presence of I-TFA to be noted only by the term "partially hydrogenated fat" in the list  
22 of ingredients. Most consumers do not appreciate the hazard concealed therein.

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4 1 Societal pressure on food producers has undoubtedly resulted in a reduction in the population-level  
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6 2 mean intake of I-TFA from 2005 to 2009, especially in Western EU countries[11].  
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8 3 However, this study demonstrated that a high intake of I-TFA is still possible in Eastern EU countries.  
9  
10 4 This problem will continue as long as popular foods with a high concentration of I-TFA are available.  
11  
12 5 Even though labelling foods with I-TFA contents may further reduce the mean intake of I-TFA, such  
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14 6 labelling still allows the intake of high amounts of these fatty acids, first because fast food is not  
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16 7 labelled and second because consumers might not pay attention to or understand the labelling[14-15].  
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18 8 A further advantage of a legislative limit on I-TFA content is that it does not require the population to  
19  
20 9 learn about the health risks of I-TFA or to pay attention to the labelling of food products. It is also  
21  
22 10 much easier and cheaper to monitor the presence of I-TFA in foods than it is to monitor the actual  
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24 11 intake of I-TFA in at-risk population subgroups.  
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26 12 In EU Austria and Denmark have shown that the health risk that a high intake of I-TFA causes, can be  
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28 13 eliminated for the entire population without any noticeable side effects for consumers. This has the  
29  
30 14 added advantage of creating a “level playing field” for suppliers. All are equally challenged. All can  
31  
32 15 profit from experience of successful and rapid adaptation as in Denmark. It remains to be investigated  
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34 16 to what extent the difference of availability of I-TFA in popular foods between and Eastern and  
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36 17 Western EU countries contributes to the much higher mortality of coronary heart disease in Eastern,  
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38 18 than in Western EU-countries (Fig. 4)[10].  
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#### 49 **What this paper adds box**

##### 50 51 WHAT IS ALREADY KNOWN ON THIS TOPIC

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54 22 A daily intake of approximately 5 g of industrial *trans* fatty acids is associated with a 23% increase in  
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56 23 the risk of coronary heart disease.  
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4 1 In the EU Austria and Denmark have shown that a high intake of I-TFA can be eliminated by a  
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6 2 legislative ban, without any noticeable side effects for consumers.  
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#### 10 11 4 WHAT THIS STUDY ADDS 12

13 5 A decline since 2005 in the amounts I-TFA in popular foods in Western EU countries is observed  
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16 6 In Eastern EU countries, however, the amount of I-TFA in these products is, in spite of some reduction,  
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18 7 still high.  
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20 8 A low average intake of I-TFA at the population level does not preclude a very high intake among  
21  
22 9 some subgroups.  
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25 10 Most EU countries rely on food producers to voluntarily reduce the amounts I-TFA in foods with  
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27 11 variable results. However, legislation is eminently feasible, and offers a more effective, rapid and  
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29 12 equitable approach.  
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36  
37 15 **Contributors:** SS obtained funding. SS and JD were both responsible for the concept design of the  
38  
39 16 study, for collection of food items, registration and labelling. SS and JD produced the first draft of the  
40  
41 17 paper and SS, JD and AA were responsible for critical revision of the manuscript. SS is a guarantor for  
42  
43 18 the study  
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48  
49 20 **Acknowledgement:** We acknowledge the support from Jenny Vissings Foundation, University of  
50  
51 21 Copenhagen and the Department of Clinical Biochemistry, Gentofte University Hospital.  
52

53  
54 22 The study funders had no role in study design, in the collection, analysis and interpretation of data; in  
55  
56 23 the writing of the report and in the decision to submit the article for publication. The researchers' were  
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4 1 independent from funders. SS is the head of the department which provided resources for the  
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9 3 All authors had full access to all of the data in the study and can take responsibility for the integrity of  
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16 6 **Data sharing:** no additional data available.  
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20 8 **Conflicts of interest:** None of the authors have any relevant conflicts of interest.  
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23 9 The corresponding author had full access to all the data in the study and has the final responsibility for  
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### 28 11 **Competing Interest**

29  
30 12 All authors have completed the Unified Competing Interest form at

31  
32  
33 13 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author)

34  
35 14 and declare that none of the authors have relationships with companies that might have  
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37 15  
38 15 an interest in the submitted work in the previous 3 years; Their spouses, partners, or

39  
40 16 children have no financial relationships that may be relevant to the submitted work; and

41  
42 17 (4) None of the authors have non-financial interests that may be relevant to the

43 17  
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45 18 submitted work.  
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50 20 This study did not require ethics approval  
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4 1 **Legends**

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8 3 **Figure 1**

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10 4 Amounts of industrial *trans* fatty acids in 100 g of biscuits/cakes/wafers bought in six EU countries in  
11 2005 and in 2009. For both groups of countries (three Eastern EU countries and three Western EU  
12 5 countries), the products are ranked according to the concentrations of industrially produced *trans* fatty  
13 6 acids. Products were only bought if “partially hydrogenated fat” or a similar term was listed among the  
14 7 first three ingredients and if the food label indicated that the fat content exceeded 15 g of fat per 100 g.  
15 8 Fewer products in Western EU countries fulfilled the inclusion criteria compared with products in  
16 9 Eastern EU-countries.  
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34 14 **Figure 2**

35 15 Amounts of industrial *trans* fatty acids in a high-*trans* menu bought in the various countries in 2005.  
36 16 For each country, the product with the highest concentration of industrial *trans* fatty acids in each of  
37 17 the three food categories is shown.  
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46 19 **Figure 3**

47 20 Time trends for the amounts of industrial *trans* fatty acids in a high-*trans* menu bought in  
48 21 three Eastern EU countries in 2005 and 2009 and in three Western EU countries in 2005  
49 22 and 2009.  
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4 **1 Figure 4**

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6 2 Trends in coronary heart disease mortality rates, selected OECD countries, 1980-2006.

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9 3 Source: OECD Health Data 2009. The raw mortality data are extracted from the WHO

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11 4 Mortality Database, and age-standardised to the 1980 OECD population. For 2006 to 2009

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13 5 the yearly mortality for Hungary is 228, 215,205 and 204. The corresponding values for

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16 6 Denmark and for OECD-mean have not yet appeared in the OECD Health data 2011.

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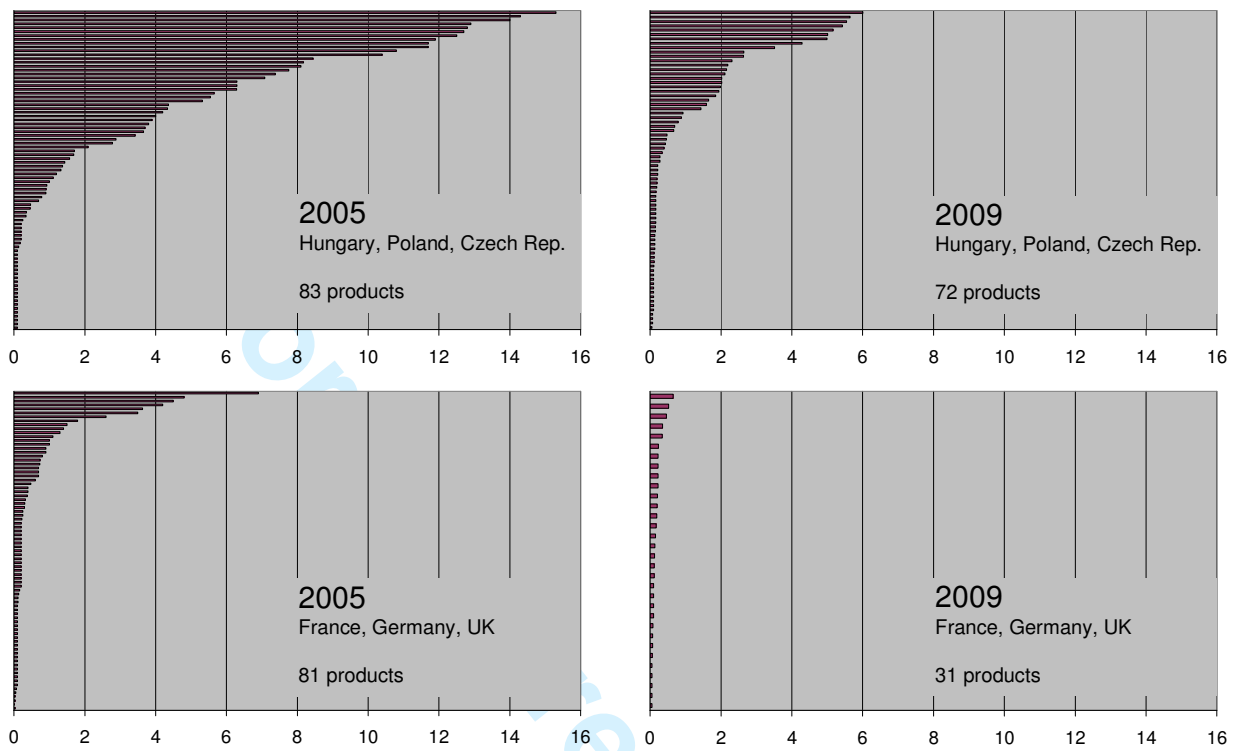
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Fig 1



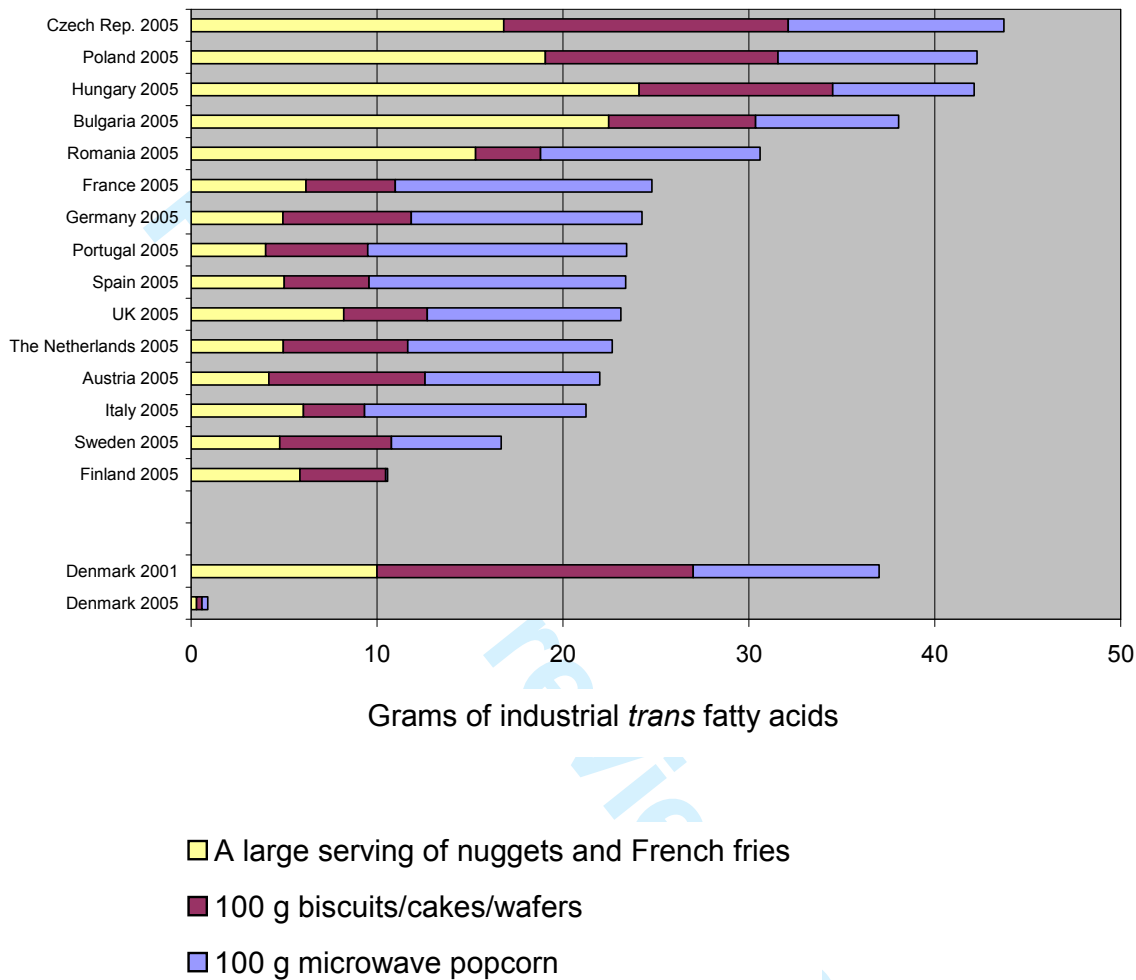
Grams of industrial *trans* fatty acids in 100 g of product

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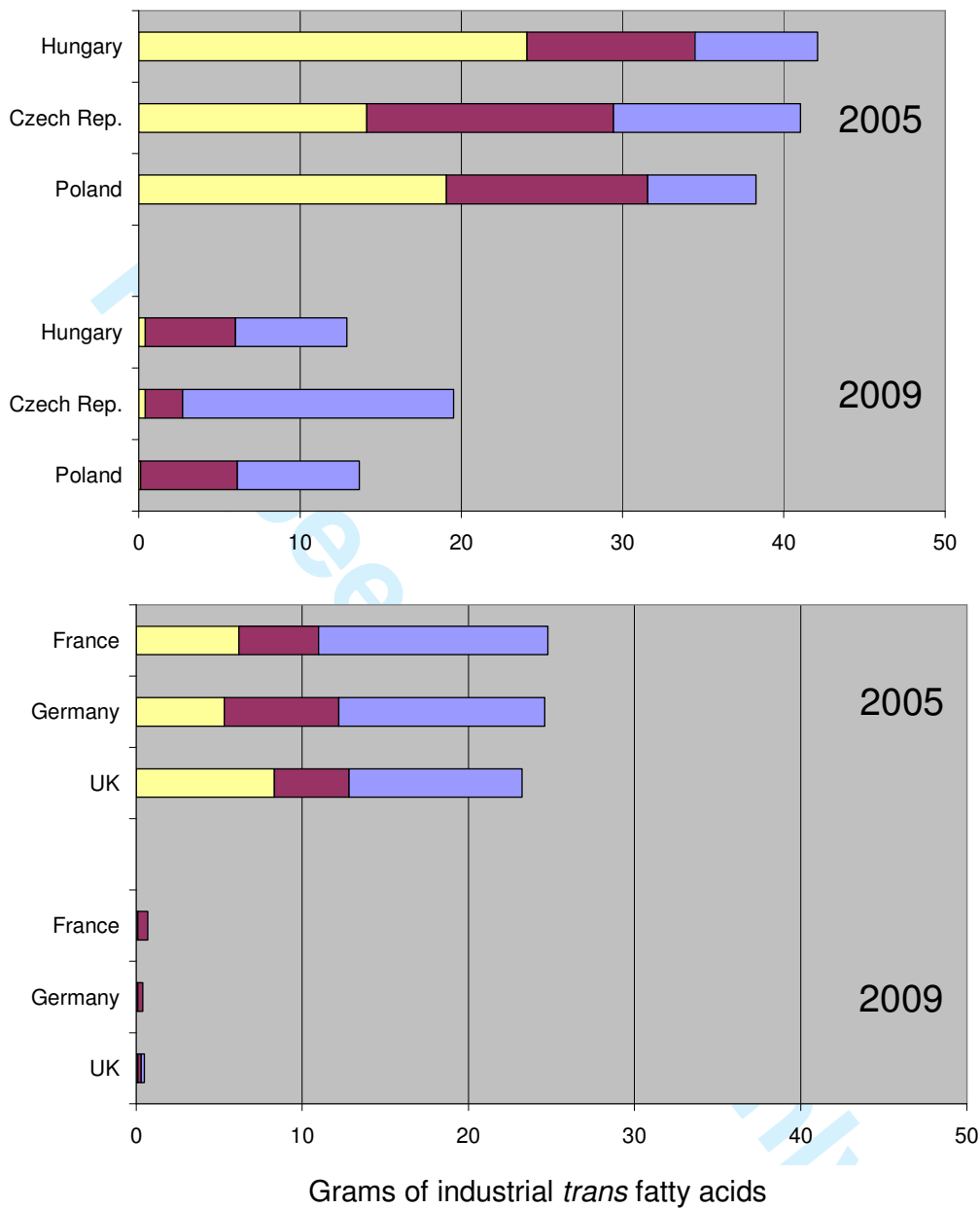
Fig 2



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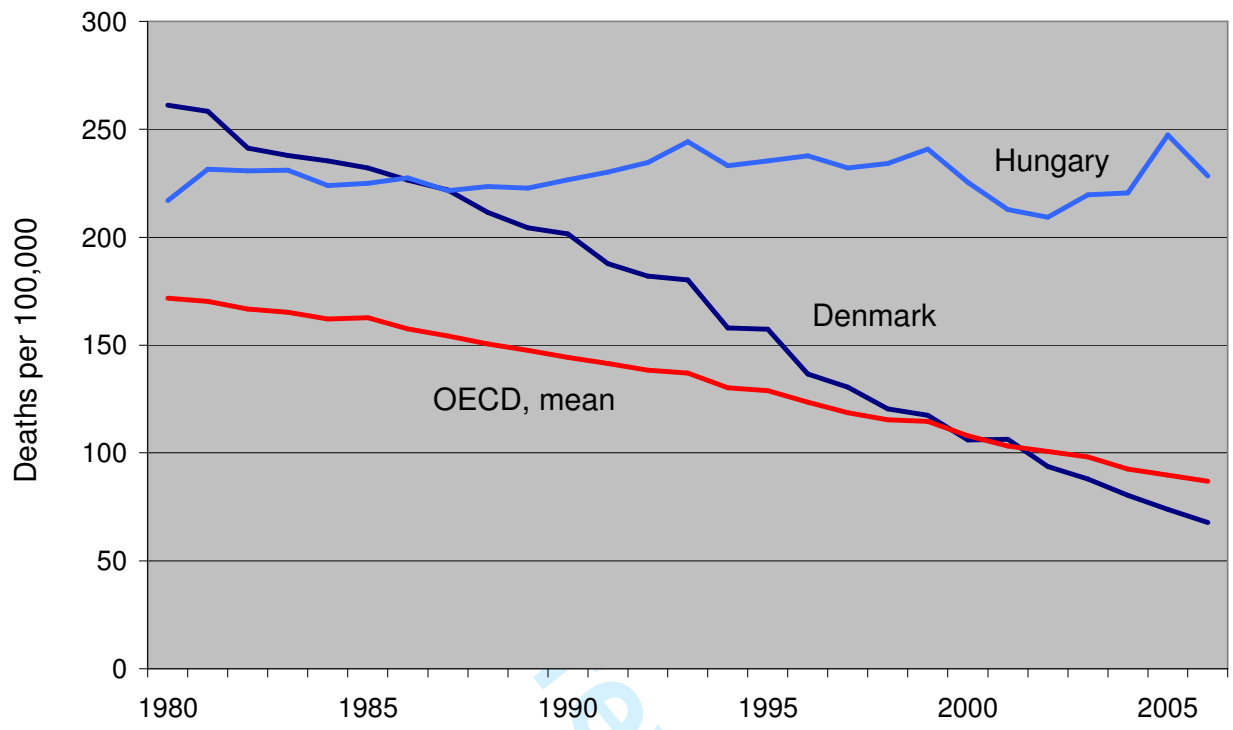
Fig 3



- A large serving of nuggets and French fries
- 100 g biscuits/cakes/wafers
- 100 g microwave popcorn

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Fig 4



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4 Reviewer 1 Comments...

5 Name: S Capewell

6 Position: Chair of Clinical Epidemiology  
7

8  
9 This is an excellent paper with very important messages for public health in  
10 the UK and Europe.  
11

12 I have no major criticisms, apart from: Figure 3 which is currently a  
13 histogram; it needs to be redrawn as a bar chart, to facilitate comparisons  
14 with Figure 2.  
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17 A new figure 3 has been made according to the reviewer's suggestion  
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21 Secondly, I do have a few suggestions to make the paper even better. Mainly by  
22 strengthening or revising specific sentences.  
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25 These are specified below, with suggested changes IN CAPITALS.  
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28 Also, I will endeavour to also send the comments as a Word "Track Changes"  
29 document, which may be MUCH easier to comprehend.  
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32 All numbers refer to line numbers in the pdf document submitted.  
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35 A trans European Union difference in the decline in trans fatty acids in  
36 popular foods - a basket investigation.  
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38

39 ABSTRACT  
40

41 Line 8 Objectives: Trans fatty acids (TFA) are produced when liquid vegetable  
42 oil is industrially hydrogenated to make it solid fat. A daily intake of  
43 approximately 5 g of TFA is associated with a 23%  
44 9 increase in the risk of CORONARY heart disease. In order to minimize the  
45 intake of TFA some countries  
46 10 have introduced labelling, while others have introduced legislative limits  
47 on the content of TFA in  
48 11 food INCLUDING AUSTRIA, DENMARK AND SWITZERLAND. HOWEVER , but most  
49 countries still rely on food producers to voluntarily reduce the TFA content  
50 in food. The  
51 12 objective of the present study was to investigate the efficiency of these  
52 strategies in the EU.  
53 13 Design: The potential consumption of TFA was assessed in a basket  
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4 investigation by analysing the TFA CONTENT in popular  
5 14 foods in 16 EU countries in 2005 and AGAIN in 2009 USING A STANDARD  
6 METHODOLOGY.  
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8 15 Samples: 70 servings of French fries and chicken nuggets, 90 packages of  
9 microwave popcorn, and  
10 16 442 samples of biscuits/cakes/wafers with "partially hydrogenated vegetable  
11 fat" listed on the label  
12  
13 17 high on the list of ingredients were analysed. A "high-trans menu" was  
14 DEFINED AS a large serving of French fries  
15 and nuggets, 100 g of microwave popcorn, and 100 g of biscuits/wafers/cakes.  
16  
17 19 Results: In 2005, a high-trans menu provided above 30 g of TFA in five EU  
18 countries in Eastern  
19 Europe (SPECIFY) and 20–30 g in eight EU countries in Western Europe  
20 (SPECIFY WHICH). In 2009 the values in Hungary, Poland,  
21 and the Czech Republic REMAINED HIGH (between 10 and 20 g), whereas they  
22 were less than 2 g. in Germany,  
23  
24 22 France and the UK,  
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#### 26 27 Conclusion:

28 In 2009 the content of TFA in popular foods in 1 Western European APPEARS LOW  
29 but not in  
30 Line 2 Eastern European EU countries. THESE FINDINGS suggest that millions of  
31 people in the EU still consume TFA in  
32 3 amounts that SUBSTANTIALLY increase their risk of CORONARY heart disease.  
33 The Austrian, Danish, and Swiss experiences  
34 4 with legally limiting TFA content in human food, demonstrate that this risk  
35 can be eliminated, with no  
36 5 noticeable effect on the availability, price, or quality of food.  
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#### 40 41 INTRODUCTION

42 Line 2 Trans fatty acids (TFA) in food originate from industrial hardening of  
43 oils and from ruminant sources.  
44 3 Compared to unhydrogenated oils, fats containing industrially produced TFA  
45 are solid at room  
46 4 temperature, have some technical advantages in food processing, and prolong  
47 the shelf life of food. HOWEVER,  
48 5 TFA can constitute up to 60% of the fats in certain foods, whereas ruminant  
49 fat contains at most 6%  
50 6 TFA. A meta-analysis of four large prospective studies found that an intake  
51 of INDUSTRIAL TFA corresponding to  
52 7 2% of the total energy intake (E %) (approximately 5 g/d) was associated  
53 with a 23% increase in the  
54 8 risk of CORONARY heart disease<sup>1</sup>. Several public health organisations have  
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4 therefore recommended that INDUSTRIAL TFA intake  
5 should be lowered as much as possible<sup>2–4</sup>. In 1976, the average intake of  
6 INDUSTRIAL TFA in Western  
7  
8 Europe was 6 g/d. In 1996, this intake had dropped to 2.6 g/d (range 1.2 to  
9 6.7 g/d), corresponding to  
10 11 0.5–2.1 E%<sup>5</sup>. Approximately half of this intake was from ruminant TFA, and  
11 only about 1.3 g was from  
12 industrial TFA, which constitutes a 78% decrease since 1976<sup>5</sup>. Despite a  
13 mean population intake of  
14 approximately 1 g of industrial TFA per day in Denmark in 2001, it was  
15 still possible to consume 20–  
16 14 30 g of TFA in a SINGLE high-trans menu by eating popular food products  
17 such as wafers, microwave popcorn,  
18 15 nuggets, and French fries<sup>4</sup>. Among the 5 million Danes, 10,000–50,000 people  
19 consumed food from  
20 this type of menu several times each week, and got a daily intake of more  
21 than 5 g TFA<sup>4</sup>.  
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30 In 2003, Canada introduced the mandatory labelling of the TFA content in pre-  
31 packaged food. In the  
32 19 same year, Denmark introduced a legislative limit of 2% industrial TFA in  
33 fat used for foods. The  
34 20 European Commission initially opposed this legislation but in MARCH 2007  
35 dropped its infringement  
36 21 proceedings against Denmark because of increased scientific evidence on the  
37 dangers of trans fats<sup>6</sup>.The  
38 22 US introduced mandatory labelling of pre-packaged food in 2006, followed by  
39 legislative limits on  
40 23 TFA in the food served in restaurants in New York City in 2008 and in 2010-  
41 11 in the state of

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45 California. In 2009, Austria and Switzerland introduced a legislative ban  
46 similar 1 to the Danish' TO BE FOLLOWED IN 2011 BY ICELAND AND SWEDEN. Of the  
47 2 EU's approximately 500 million inhabitants who consume food that still may  
48 contain high amounts of  
49 3 trans fat, Denmark's and Austria's populations, representing approximately  
50 14 million people, are the  
51 4 exceptions.  
52 5 In 2005, we assessed by a basket investigation the availability of a high-  
53 trans menu (large servings of  
54 6 French fries and nuggets, 100 g of microwave popcorn and 100 g of  
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4 biscuits/wafers/cakes) in 15 EU  
5 7 countries. , and found that, i In spite of a low mean intake, high  
6 concentrations of industrial TFA were still  
7 8 present in many popular foods. Thus, subgroups of the populations could have  
8 an intake that is  
9 9 considerably higher than the recommended upper limit for intake of TFA7. TFA  
10 in foods from  
11 10 international fast food providers was an important contributor to the high  
12 intake in these sub11  
13 populations8. Still in 2009, EU countries (with the exception of Austria and  
14 Denmark) rely on food  
15 12 producers to voluntarily reduce the amounts of TFA in foods. The present  
16 study assess the efficiency of  
17 13 that strategy in three Eastern European countries, Hungary, Poland, and the  
18 Czech Republic, and in  
19 14 three Western European countries, Germany, France, and the UK.  
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## 25 METHODS

26 In July 2009 to September 2009, the capitals of Poland, the Czech Republic,  
27 Hungary, Germany,  
28 Line 7 France, and the UK were revisited and the same procedures for the  
29 purchase of food items WERE FOLLOWED. If  
30 8 possible, the same stores were revisited and the same brands were bought.  
31 Altogether, 602 samples of  
32 9 food in EU countries were purchased  
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36

## 37 Calculation

38 For comparison, the amounts of TFA in the French fries and the chicken  
39 nuggets were expressed as the  
40 19 amounts in a serving size equivalent to a large serving from McDonald's in  
41 the US: . The serving sizes were 171 g of French fries and 160 g of chicken  
42 nuggets.  
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## 46 RESULTS

47 Line 2

48 Biscuits, cakes, and wafers

49 3 Figure 1 presents data from the products bought in the six EU countries in  
50 2005 and 2009. The  
51 4 products are ranked according to TFA content and the combined values for the  
52 three Eastern EU  
53 5 countries and for the three Western EU countries are given separately.  
54 IN 2005, THE highest TFA contents (10–  
55 6 15 g) in single 100 g servings were found in Hungary, Poland, and the Czech  
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4 Republic. In 2005 in

5 7 France, Germany, and the UK, the TFA contents were lower but still  
6 considerable (4–7 g). AVERAGING 5G EXCLUDING ONE OUTLIER

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8 In 2009 biscuits, cakes, and wafers in the three Eastern EU countries  
9 contained a smaller, but still

10 substantial, amount of TFA (4–6 g in Figure 3). In contrast, the TFA content  
11 in products in the three Western EU

12 countries was minimal (< 1 g). The same pattern was observed in each of the  
13 countries.  
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18 Fast food

19 Line 13

20 In 2005, the TFA content of the McDonald's servings in EU varied from less  
21 than 1 g in Copenhagen

22 14 to 7 g in London, UK. For KFC servings, there were even larger differences  
23 between the countries,

24 15 ranging from less than 1 g in Germany to 24 g in Hungary. 15 percent of the  
25 54 fast food servings

26 16 contained more than 10 g per serving, and 50% contained between 5 and 10  
27 g8. (Figure 2)

28  
29 In 2009, each of the 12 fast food menus, which were collected FRANCE,  
30 GERMANY AND THE UK in the same locations as in 2005,

31 18 contained less than 1 g of TFA per serving (Figure 3).

32  
33  
34 19

35  
36 20

37 Popcorn

38 Line 21 The highest TFA content in a single 100 g serving of microwave oven  
39 popcorn bought in each country IN 2005

40 22 is presented in the data given for the TFA content in the high-trans menu  
41 for that country (Fig. 2), 6-12g

42  
43  
44 In 2009, the microwave oven popcorn samples with the highest 1 amounts of TFA,  
45 which were from

46 2 Hungary, Poland and the Czech Republic, contained the same similar amounts  
47 of TFA as the popcorn that we

48 3 analysed in 2005, 8-16g. In contrast, the TFA in popcorn from Germany,  
49 France, and UK in 2005 (10-13g) was negligible by 2009 (Fig. 3).

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55 A high-trans menu

56 Line 7 In 2001, the potential consumption of TFA by eating a high-trans menu  
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4 was 37 g in Denmark, but by  
5 8 2005, this potential consumption level was reduced to less than 1 g (Fig.  
6 2). In 2005, by contrast, the  
7 9 potential consumption level via a high-trans menu exceeded 20 g in 13 out of  
8 the 16 EU-countries,  
9 10 from which foods were investigated. Hungary, the Czech Republic, and Poland  
10 ranked among the  
11 11 highest, with values being around 40 g per menu. A considerable amount of  
12 the TFA in the menus was  
13 12 derived from the fast food meal.  
14 13 Figure 3 demonstrates the time trends for TFA in the high-trans menu in  
15 Hungary, the Czech Republic,  
16 14 Poland, Germany, France, and the UK. In all of the countries, the  
17 contribution values obtained from  
18 15 McDonald's and KFC meals (NUGGETS AND FRIES) in 2009 were negligible  
19 compared to the values obtained in 2005.  
20 16 In 2009, biscuits, cakes, wafers, and microwave oven popcorn were still  
21 high in TFA in Eastern EU  
22 17 countries. In contrast, only small amounts of TFA in THESE SAME products  
23 obtained in Western EU countries  
24 18 were found.  
25 19

### 33 Implications

34 7 An intake of above 5 g of TFA daily is associated with a health risk that  
35 can be eliminated more easily  
36 8 than many other diet-associated health risks. This issue is particularly  
37 relevant to low-income groups  
38 9 such as taxi and truck drivers AND MANUAL LABOURERS who, due to other  
39 lifestyle factors, already have an increased risk of CORONARY HEART DISEASE  
40 10 and who may also more frequently eat foods with a high TFA content.  
41 11 In 2011, EU countries, with the exception of Austria and Denmark, legally  
42 allow foods with the  
43 12 maximum concentration of TFA in the fat (i.e. 60%) to be sold without any  
44 notice as long as the food is  
45 13 unpackaged (as is the case for restaurants and fast food outlets). If the  
46 food is pre-packaged, then the  
47 14 law requires the presence of TFA to be noted only by the term "partially  
48 hydrogenated fat" in the list of  
49 15 ingredients. MOST CONSUMERS DO NOT APPRECIATE THE HAZARD CONCEALED  
50 THEREIN. (REF)  
51 16 Societal pressure on food producers has undoubtedly resulted in a reduction  
52 in the population-level  
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4 17 mean intake of TFA from 2005 to 2009, especially in Western EU countries.  
5 (ref)

6  
7 18 However, this study demonstrated that a high intake of TFA is still  
8 possible in Eastern EU countries.

9  
10 19 This problem will continue as long as popular foods with a high  
11 concentration of TFA are available.

12 20 Even though labelling foods with TFA contents may further reduce the mean  
13 intake of TFA, such

14 21 labelling still allows the intake of high amounts of these fatty acids,  
15 first because fast food is not

16 22 labelled and second because consumers might not pay attention to the  
17 labelling OR UNDERSTAND.

18  
19 A further advantage of a legislative limit on TFA content is that it does 1  
20 not require the population to

21 2 learn about the health risks of TFA or to pay attention to the labelling of  
22 food products. It is also MUCH easier

23 3 and cheaper to monitor the presence of TFA in foods than it is to monitor  
24 the actual intake of TFA in

25 4 at-risk population subgroups.

26  
27 5 Austria and Denmark have shown that the health risk that a high intake of  
28 industrially produced trans

29 6 fatty acids causes can be eliminated for the entire population without any  
30 noticeable side effects for

31 7 consumers.

32  
33 THIS HAS THE ADDED ADVANTAGE OF CREATING A "LEVEL PLAYING FIELD" FOR  
34 SUPPLIERS. ALL ARE EQUALLY CHALLENGED. ALL CAN PROFIT FROM EXPERIENCE OF  
35 SUCCESSFUL AND RAPID ADAPTATION AS IN DENMARK. (refs) It remains to be

36  
37 investigated to what extent the difference of availability of TFA in popular  
38 8 foods between and Eastern and Western EU countries contributes to the much  
39 higher CHD mortality

40 9 in CENTRAL EUROPE, than in Western EU-countries (Fig. 4) 10.

41 10

42  
43 11 What this paper adds box

44 12 WHAT IS ALREADY KNOWN ON THIS TOPIC

45 13 A daily intake of approximately 5 g of industrially produced trans fatty  
46 acids (TFA) is associated with

47 14 a 23% increase in the risk of CORONARY heart disease.

48 15 In the EU Austria and Denmark have shown that a high intake of TFA can be  
49 eliminated by a

50 16 legislative ban, without any noticeable side effects for consumers.

51 17

52 18 WHAT THIS STUDY ADDS

53 19

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3  
4 A DECLINE SINCE 2005 IN THE AMOUNTS TFA IN POPULAR FOODS IN WESTERN EU  
5 COUNTRIES IS OBSERVED.  
6  
7 23 IN EASTERN EU COUNTRIES, HOWEVER, THE AMOUNT OF TFA IN THESE PRODUCTS IS  
8 STILL HIGH  
9

10 A low average intake TFA at the population level does not preclude a very  
11 high intake among some  
12 20 subgroups.  
13  
14 21 Most EU countries rely on food producers to voluntarily reduce the amounts  
15 TFA in foods, WITH VARIABLE RESULTS.  
16  
17 22  
18 However, legislation is eminently feasible, and offers a more effective, rapid  
19 and equitable approach.  
20

21  
22 Fig 1

23 Line 32 Grams of industrially produced trans fatty acids in 100 g of  
24 product  
25

26  
27 We need some figures for 2009  
28

29 Figure 3

30 HISTOGRAM LOOKS ODD. IT NEEDS TO BE CHANGED INTO A BAR CHART, TO FACILITATE  
31 COMPARISON WITH FIGURE 2  
32

33 [The figure has been changed as suggested](#)  
34

35 Figure 4

36 HUNGARY TRENDS LOOK ODD. MORTALITY FALLS ARE NOW OCCURRING THERE TOO.

37 [We have added the new available figures for 2007, 2008, and 2009](#)  
38  
39

40  
41 [In conclusion we have followed all of the suggestions from this reviewer and we appreciate his](#)  
42 [thorough work with our manuscript](#)  
43  
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---

49  
50  
51 [Reviewer 2 Comments...](#)

52 Name: Andrew Odegaard PhD, MPH

53 Position: Research Associate

54 COMMENTS FOR THE AUTHOR  
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4 The authors have carried out what appears to be a case study that aims to  
5 examine the efficiency of relying on producers to voluntarily reduce TFA in  
6 foods with historically high TFA content. Indeed, the authors have an extensive  
7 and noteworthy background on this public health area.  
8  
9

10 They found major fast food corporations seem to be self-regulating overall in  
11 Europe, biscuits/crackers makers to an extent in Eastern and certainly in  
12 Western Europe, where microwave popcorn is self-regulated in Western, but not  
13 Eastern Europe. Essentially, 4.5 of the possible 6 areas of possible TFA  
14 reduction occurred with self-regulation. (those 1.5 areas being only a partial  
15 reduction in TFA in biscuits/crackers and no evident change in popcorn in  
16 Eastern EU).  
17  
18  
19

20 They also report that legislation worked in Denmark to essentially eliminate TFA.  
21  
22

23 This work is certainly original in that it provides a snap shot, to some extent,  
24 on TFA in foods with traditional high levels of TFA, and is probably most  
25 relevant to policy makers, since that is what the author's are arguing for.  
26  
27

28 That said, there are a number of points that could be sharpened to improve this  
29 as a scientific research article as it currently reads as more of a hybrid of  
30 original research and advocacy paper or editorial.  
31  
32

33 I've provided general and specific comments below that I hope are helpful.  
34  
35

36 General

37 The focus should emphasize "industrial" TFA throughout the paper.  
38  
39

40 Some readers may quibble with the use of "ischemic" instead of Coronary Heart  
41 Disease, but this is immaterial if defined specifically using and ICD code for  
42 example.  
43  
44

45 [We have replaced the word ischemic with coronary heart disease as also suggested by](#)  
46 [reviewer 1](#)  
47

48 Given the study design and approach- was the follow up assessment in 2009  
49 planned in 2004/5 or was this opportunistic use of data? Either way, it provides  
50 interesting results from a number of perspectives.  
51  
52

53 I think the title may be misleading – the aim seems to have been to assess a  
54 high-TFA menu based on items from three different avenues of processed foods  
55 that are likely widely available. There is no evidence provided that these are  
56 actually popular items or the per capita consumption is high.  
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5 We assume the popularity of these products because they were stocked at the supermarkets.  
6 They are only stocked there because they are sold in considerable amounts. This is mentioned  
7 in the manuscript.  
8

9 The competition between food producers of having their products on the shelves in large  
10 supermarkets is fierce. Only products with a sufficient turnover are allowed to be there.  
11

12  
13 The popularity of foods from McDonald and KFC in large cities is inferred from the same  
14 argumentation.  
15

16  
17 As well, the abstract conclusion could use more nuance- the fast food reported  
18 in Eastern EU was self regulated according to your results.  
19

20  
21 We have modified the conclusion by adding the sentence "in spite of some reduction" (in  
22 Eastern Europe)  
23

24 Introduction:

25  
26  
27 -The sentence beginning in line 5 needs a reference for the values provided.

28 We have provided the following reference: Wahle KWJ, James WPT. Isomeric fatty acids and  
29 human health.

30 Eur J Clin Nutr 1993; 47: 828-39.  
31

32  
33 -An estimate of 0.2-1.0% of the Danish population eats this way according to  
34 data provided. Is this a public health issue if similar percentages of these  
35 other countries are doing the same? An approach aiming to show this would  
36 strengthen the article for the audience. This also relates to the title (popular  
37 foods).  
38

39  
40 We have in line 17 page 4 added the sentence: "Generalizing to the population in the EU, this  
41 corresponds to 1-5 million people"  
42

43  
44 -Are readers going to be confused on what a "basket investigation" is? If there  
45 is an actual definition- this essentially seems to be a case study  
46

47  
48 We have now replaced the word basket with the words "market basket" In PubMed.com the  
49 search term "market basket" generates 20 titles using the term in the title and 155 papers  
50 using the term in the text. Most of the papers deal with the content of toxic components in  
51 foods.  
52

53 Reviewer 2 finds the study to be a case study. We report however 600 cases, which are the  
54 number of foods, analysed for TFA  
55

56  
57 Pg 5 line 11- Earlier it was noted that Switzerland also had introduced a  
58  
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4 legislative ban on TFA, which one is it?  
5  
6

7 The sentence in the paper reads: "Still in 2009, EU countries (with the exception of Austria and  
8 Denmark) rely on food producers to voluntarily reduce the amounts of I-TFA in foods."

9 Switzerland is not an EU country.

10 The legislative ban in Switzerland is similar to the legislative ban in Denmark and is mentioned  
11 in the text.  
12  
13

#### 14 15 16 Methods

17  
18 How were the countries chosen- at random or based on available data?  
19

20 As mentioned in the text: "The cities included were partly determined by visits taken by the  
21 authors and their colleagues for other purposes, and these visits were supplemented by  
22 arranged visits by two of the authors (SS, JD)."

23 In 2005 (fig 2) we intended to include as many EU countries as economically feasible.

24 In 2009 we revisited the 3 eastern EU-countries that had the highest values for the high *trans*-  
25 menu: Czech Republic, Poland and Hungary and decided to compare with 3 large western EU  
26 countries: Germany, France, and UK.  
27  
28

29  
30 Is there any estimate to the prevalence of said "high density" TFA foods in the  
31 supermarkets, for example, what % of microwave popcorn was in this range?  
32  
33

34 We did not count the total number of different brands of micro wave popcorn or of biscuits. We  
35 used the inclusion criteria as given in the text: "Microwave oven popcorn and  
36 biscuits/cakes/wafers were bought if "partially hydrogenated fat" or a similar term was listed  
37 among the first three ingredients and if the food label indicated that the fat content exceeded  
38 15 g of fat per 100 g."  
39  
40

41 Is there any data on the frequency of consumption of these popular products?  
42  
43

44 Not to our knowledge. As already mentioned we rely on the assumption that when the  
45 products are present in large supermarkets, they have a considerable turnover.

46 We have considered using the term "availability of food with high content of trans fatty acids".  
47 However this term does not reflect that the foods were bought only in large supermarkets.  
48  
49  
50

#### 51 52 Results

53 Were fewer products purchased in Western Europe due to availability? Or what was  
54 the reason there is the large sample difference?  
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4 In Western Europe we were in 2009 not able to find the same number of foods that fulfilled the  
5 inclusion criteria: "Microwave oven popcorn and biscuits/cakes/wafers were bought if "partially  
6 hydrogenated fat" or a similar term was listed among the first three ingredients and if the food  
7 label indicated that the fat content exceeded 15 g of fat per 100 g."

8  
9  
10 The number of different brands was probably more or less the same, but in Western Europe  
11 most of them were in 2009 not any longer labelled with the term "partially hydrogenated fat"  
12 or a similar and when they were, the products contained only small amounts of trans fat.

13  
14 In the legend to fig 1 we have added the following sentences: "Products were only bought if  
15 "partially hydrogenated fat" or a similar term was listed among the first three ingredients and  
16 if the food label indicated that the fat content exceeded 15 g of fat per 100 g". Fewer products  
17 in Western EU countries fulfilled in 2009 the inclusion criteria compared with the situation in  
18 Eastern EU-countries.  
19  
20  
21

### 22 23 Limits

24 Line 4, pg 10- the selective pattern of purchasing could also have led to an  
25 overestimate of amounts of TFA in subgroups  
26  
27

28 Our argumentation supports an underestimation.  
29  
30

### 31 Implications

32 A reference should be provided on the point related to "low income groups", and  
33 other lifestyle factors.

34 We wrote: low-income groups.. who due to other lifestyle factors, already have an increased  
35 risk of coronary heart disease and who may also more frequently eat foods with a high I-TFA  
36 content  
37

38 We have added the following reference: Gill PE and Wijk K Case study of a healthy eating  
39 intervention for Swedish lorry drivers Health Education Research 2004 vol. 19 no.3:306-315  
40  
41

42 Same with the statement regarding regulation of TFA in the EU.

43 We have added the following reference: Legislation relating to the level of industrially  
44 produced trans fatty acids in food p45-49 in: The influence of trans fatty acids on health-  
45 fourth edition 2004, WWW.meraadet.dk  
46  
47

48 Again, with the statement beginning with "societal pressure on....".

49 We have added the following reference: Katan MB Regulation of trans fats: The Gap, the  
50 Polder, and McDonald's French fries. Atherosclerosis Supplements 7 (2006) 69-71  
51  
52

53 Again, citing the effectiveness or how non-effective labeling actually is for  
54 the consumer.

55 We have added 2 references  
56  
57  
58  
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60



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3  
4 Consumers find food labelling confusing:

5 <http://www.guardian.co.uk/money/2009/may/07/food-drink-health-labels>  
6  
7

8 Borra S. Consumer perspectives on food labels. *Am J Clin Nutr.* 2006 May;83(5):1235S.  
9

10 The ecological data from Denmark on overall IHD(CHD) rates strengthen this  
11 discussion and paper, but mention of other factors that may play into this  
12 decrease is appropriate. As well, if similar data is available from Austria.  
13 Certainly, providing data from all the countries noted in this study would be  
14 best, as well as discussion of the potential "ecological fallacy".  
15  
16

17  
18 With our last sentence in the paper we mention that Trans fatty acids may play a role in the  
19 difference in mortality. Our study does not deal with other and more conventional risk factors  
20 such as smoking , hypertension.  
21  
22

23 By only depicting Hungary and Denmark and the mean for all OECD countries we find the  
24 figure much less complicated compared with a figure that have values for all 6 countries.  
25  
26

27 Due to space constraint we have not dealt with ecological inference fallacy  
28

29 Overall, I think more balance could be added to this discussion- this paper  
30 reads more like an advocacy paper or editorial with some general data. Further  
31 discussion on other reasons that self-regulation by producers works in some  
32 instances, but not all and reasons why different sectors of food producers are  
33 slower to change in the Eastern EU, and so on. Essentially, the authors would  
34 much better persuade the audience of the need for legislation in Eastern EU (and  
35 globally?) by using this approach, in this reviewers mind.  
36  
37  
38  
39

40 PRIVATE COMMENTS FOR THE EDITOR:

41 I'm not real sure what to think of this paper. The authors have provided some  
42 interesting data, which actually could be interpreted that self-regulation works  
43 in some instances, yet the focus, and it seems a bit hasty, doesn't seem to  
44 actualize this and the paper doesn't provide the necessary details, or nuance to  
45 make this seem like a scientific study. Would an observational study that  
46 provided this level of opaqueness even be reviewed? These comments are coming  
47 from a researcher who ardently believes reducing and eliminating TFA from the  
48 food supply and reducing intake of the foods it is historically common in is a  
49 significant public health issue.  
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**A trans European Union difference in the decline in trans fatty acids in popular foods - a market basket investigation.**

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<b>Primary Subject Heading</b>:	Health policy
Secondary Subject Heading:	Cardiovascular medicine, Nutrition and metabolism, Public health, Occupational and environmental medicine
Keywords:	Coronary heart disease < CARDIOLOGY, NUTRITION & DIETETICS, PREVENTIVE MEDICINE, Cardiac Epidemiology < CARDIOLOGY

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7 2 **A trans European Union difference in the decline in *trans* fatty acids in**  
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10 3 **popular foods - a market basket investigation.**

11  
12 4 Steen Stender<sup>1</sup>, Arne Astrup<sup>2</sup> and Jørn Dyerberg<sup>1</sup>  
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4 1 Key words: 1. Trans fatty acids 2. Fast food 3. Eastern Europe 4. Western Europe 5. Legislation

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6 2 Word count: 2994 (30-7-2012)

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## 22 9 **Article summary**

### 23 24 10 **Article focus**

25  
26 11 Are popular foods with high amounts of industrial *trans* fatty acids still available in EU-countries in 2009 to the  
27 12 same extent as it was in 2005

28  
29 13 Is there a difference in availability of such foods between Western and Eastern EU-countries  
30  
31  
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34

### 35 15 **Key messages**

36  
37 16 Industrial *trans* fatty acids in popular foods in Western EU-countries have declined considerably since 2005. In

38  
39 17 Eastern Europe industrial *trans* fatty acids in some popular foods are in spite of some decline still high

40  
41 18 A low average intake of industrial *trans* fatty acids at the population level does not preclude a high intake among  
42 19 subgroups

43  
44 20 Most EU countries rely on food producers to voluntarily reduce the amounts of industrial *trans* fatty acids in  
45  
46 21 foods with variable results. An effective alternative is legislation so far only used by a few EU-countries  
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### 52 23 **Strengths and limitations**

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4 1 A strength is the measurement of *trans* fatty acids in many popular foods in several EU-countries in 2005 and  
5  
6 2 again in 2009  
7  
8 3 A limitation is that the average daily intake of trans fatty acids was not measured in subgroups of the population,  
9  
10 4 but instead inferred from the popularity of fast food and from the presence of popular foods with high amounts  
11  
12 5 of industrial trans fatty acids in large supermarkets  
13  
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15 6

## 7 **ABSTRACT**

16  
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19  
20 8 **Objectives:** To minimize the intake of industrial *trans* fatty acids(I-TFA) some countries have introduced  
21  
22 9 labelling, while others have introduced legislative limits on the content of I-TFA in food. However, most  
23  
24 10 countries still rely on food producers to voluntarily reduce the I-TFA content in food. The objective of the  
25  
26 11 present study was to investigate the efficiency of these strategies in the EU.  
27

28 12 **Design:** The potential consumption of I-TFA was assessed in a market basket investigation by analysing the I-  
29  
30 13 TFA content in popular foods.  
31  
32

33 14 **Setting:** A standardized purchase methodology was used in 16 EU countries in 2005 and again in 2009.  
34

35 15 **Samples:** 70 servings of French fries and chicken nuggets, 90 packages of microwave popcorn, and 442 samples  
36  
37 16 of biscuits/cakes/wafers with “partially hydrogenated vegetable fat” listed high on the list of ingredients were  
38  
39 17 analysed. A high-*trans* menu was defined as a large serving of French fries and nuggets, 100 g of microwave  
40  
41 18 popcorn, and 100 g of biscuits/wafers/cakes.  
42  
43

44 19 **Results:** In 2005, a high-*trans* menu provided above 30 g of I-TFA in five EU countries in Eastern Europe and  
45  
46 20 20–30 g in eight EU countries in Western Europe. In 2009 the values in Hungary, Poland, and the Czech  
47  
48 21 Republic remained high between 10 and 20 g, whereas they were less than 2 g in Germany, France and the UK.  
49

50 22 **Conclusion:** In 2009 contents of I-TFA in popular foods in Western Europe appear low but, in spite of some  
51  
52 23 reduction, still high in Eastern European EU countries. These findings suggest that millions of people in the EU  
53  
54 24 still consume I-TFA in amounts that substantially increase their risk of coronary heart disease.  
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## 1 INTRODUCTION

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6  
7 2 *Trans* fatty acids (TFA) in food originate from industrial hydrogenation of oils and from ruminant  
8  
9 3 sources. Compared to unhydrogenated oils, fats containing industrial *trans* fatty acids (I-TFA) are  
10  
11 4 solid at room temperature, have some technical advantages in food processing, and prolong the shelf  
12  
13  
14 5 life of food. However I-TFA can constitute up to 60% of the fats in certain foods, whereas ruminant fat  
15  
16 6 contains at most 6% TFA[1]. A meta-analysis of four large prospective studies found that an intake of  
17  
18 7 TFA corresponding to 2% of the total energy intake (E %) (approximately 5 g/d) was associated with a  
19  
20  
21 8 23% increase in the risk of coronary heart disease [2]. Several public health organisations have  
22  
23 9 recommended that I-TFA intake should be lowered as much as possible [3-5]. In 1976, the average  
24  
25  
26 10 intake of TFA in Western Europe was 6 g/d. In 1996, this intake had dropped to 2.6 g/d (range 1.2 to  
27  
28 11 6.7 g/d), corresponding to 0.5–2.1 E% [6]. Approximately half of this intake was from ruminant TFA  
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30  
31 12 and only about 1.3 g was from I-TFA, which constitutes a 78% decrease since 1976[6]. Despite a mean  
32  
33 13 population intake of approximately 1 g of I-TFA per day in Denmark in 2001, it was still possible to  
34  
35 14 consume 20–30 g of I-TFA in a single high-*trans* menu by eating popular food products such as wafers,  
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37  
38 15 microwave popcorn, nuggets, and French fries [5]. Among the 5 million Danes, 10,000–50,000 people  
39  
40 16 consumed food from this type of menu several times each week, and got a daily intake of more than 5 g  
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42 17 I-TFA [4]. Generalizing to the population in the EU, this corresponds to 1-5 million people.  
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47 19 In 2003, Canada introduced the mandatory labelling of the I-TFA content in pre-packaged food. In the  
48  
49 20 same year, Denmark introduced a legislative limit of 2% I-TFA in fat used for foods. The European  
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52 21 Commission initially opposed this legislation but in March 2007 dropped its infringement proceedings  
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54 22 against Denmark because of increased scientific evidence on the dangers of *trans* fats [7]. The US  
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56 23 introduced mandatory labelling of pre-packaged food in 2006, followed by legislative limits on I-TFA  
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4 1 in the food served in restaurants in New York City in 2008 and in 2010-11 in the state of California. In  
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6 2 2009, Austria and Switzerland and in 2011 Iceland introduced a legislative ban similar to the Danish'  
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8 3 to be followed also by Sweden. It means that in 2012 only a minority i.e. approximately 14 million  
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10 4 people of the 500 million people in EU are protected by legislation against foods with high amounts of  
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13 5 I-TFA..

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16 6 In 2005, we assessed by a market basket investigation the availability of a high-*trans* menu (large  
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18 7 servings of French fries and nuggets, 100 g of microwave popcorn and 100 g of biscuits/wafers/cakes)  
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20 8 in 15 EU countries, and found that, in spite of a low mean intake, high concentrations of I-TFA were  
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22 9 still present in many popular foods. Thus, subgroups of the populations could have an intake that is  
23  
24 10 considerably higher than the recommended upper limit for intake of I-TFA [8]. I-TFA in foods from  
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26 11 international fast food providers was an important contributor to the high intake in these sub-  
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28 12 populations [9]. Still in 2009, EU countries (with the exception of Austria and Denmark) rely on food  
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30 13 producers to voluntarily reduce the amounts of I-TFA in foods. The present study assess the efficiency  
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32 14 of that strategy in three Eastern European countries, Hungary, Poland, and the Czech Republic, and in  
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34 15 three Western European countries, Germany, France, and the UK.  
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## 42 17 **METHODS**

### 43 18 **Purchase of food products**

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45 19 Between November 2004 and January 2006, 542 items of foods were purchased in 26 countries. The  
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47 20 cities included were partly determined by visits taken by the authors and their colleagues for other  
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49 21 purposes, and these visits were supplemented by arranged visits by two of the authors (SS, JD). The  
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51 22 tourist office in the city was asked to identify three large supermarkets in the vicinity, preferably chain  
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4 1 supermarkets with many large shops in the capital and across the country. A written procedure was  
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6 2 followed that included details about which products to select and instructions for storage methods until  
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8 3 the food could be returned to the laboratory. Fast food items (chicken nuggets and French fries) were  
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10 4 obtained from McDonald's and KFC outlets. Microwave oven popcorn and biscuits/cakes/wafers were  
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12 5 bought if "partially hydrogenated fat" or a similar term was listed among the first three ingredients and  
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14 6 if the food label indicated that the fat content exceeded 15 g of fat per 100 g.  
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18 7 In July 2009 to September 2009, the capitals of Poland, the Czech Republic, Hungary, Germany,  
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20 8 France, and the UK were revisited and the same procedures for the purchase of food items were  
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22 9 followed. If possible, the same stores were revisited and the same brands were bought. Altogether, 602  
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24 10 samples of food in EU countries were purchased  
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## 28 11

### 29 12 **Analysis for TFA**

30 13 The microwave popcorn was popped before processing. The foods were homogenised, and the fatty  
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32 14 acid content was analysed by gas chromatography (GC) on a 100-m highly polar capillary column.  
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35 15 Thin layer chromatography on silver nitrate-impregnated silica with renewed GC verified the  
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37 16 results[10]. The method is accredited by the Danish Accreditation Authorities (DANAK) according to  
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39 17 ISO 17025.  
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### 46 19 **Calculation**

47 20 For comparison, the amounts of I-TFA in the French fries and the chicken nuggets were expressed as  
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49 21 the amounts in a serving size equivalent to a large serving from McDonald's in the US. The serving  
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51 22 sizes were 171 g of French fries and 160 g of chicken nuggets.  
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4 1 The potential consumption of I-TFA in a given country was defined as the sum of the I-TFA contents  
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6 2 provided by a high-*trans* menu that consisted of products with the highest identified amount of I-TFA.  
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### 9 **RESULTS**

#### 10 **Biscuits, cakes, and wafers**

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14 5 Figure 1 presents data from the products bought in the six EU countries in 2005 and 2009. The  
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16 6 products are ranked according to I-TFA content and the combined values for the three Eastern EU  
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18 7 countries and for the three Western EU countries are given separately. The highest I-TFA contents (10–  
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20 8 15 g) in single 100 g servings in 2005 were found in Hungary, Poland, and the Czech Republic. In  
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22 9 France, Germany, and the UK, the I-TFA contents were lower but still with many above 2 g in 100 g  
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24 10 product.  
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28 11 In 2009 biscuits, cakes, and wafers in the three Eastern EU countries contained a smaller, but still  
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30 12 substantial, amount of I-TFA. In contrast, the I-TFA content in products in the three Western EU  
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32 13 countries was minimal (< 1 g). The same pattern was observed in each of the countries.  
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35 14 Only in few cases was the same brand of biscuits, cakes and wafers from the 2005 purchase included in  
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37 15 the 2009 purchase either because it had disappeared from the shop or because it did no longer have the  
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39 16 term partially hydrogenated fat on the list of ingredients. When the same brand was included in the  
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41 17 purchases the amount of I-TFA in that brand has declined from 2005 to 2009, but other brands with  
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43 18 higher amounts have appeared on the shelves.  
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47 19 The values in Fig 1 are given in table 1 for each food item from each country.  
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#### 51 **Fast food**

52 21  
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54 22 In 2005, the I-TFA content of the McDonald's servings in EU varied from less than 1 g in Copenhagen  
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56 23 to 7 g in London, UK. For KFC servings, there were even larger differences between the countries,  
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4 1 ranging from less than 1 g in Germany to 24 g in Hungary. 15 percent of the 54 fast food servings  
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6 2 contained more than 10 g per serving, and 50% contained between 5 and 10 g[9].  
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9 3 In 2009, each of the 12 fast food menus, which were collected in France, Germany and the UK in the  
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11 4 same locations as in 2005, contained less than 1 g of I-TFA per serving (Figs. 2 and 3).  
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## 16 6 **Popcorn**

17  
18 7 The highest I-TFA content in a single 100 g serving of microwave oven popcorn bought in each  
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20 8 country is presented in the data given for the I-TFA content in the high-*trans* menu for that country  
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22 9 (Fig. 2 and table 2) .  
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25 10 In 2009, the microwave oven popcorn samples with the highest amounts of I-TFA, which were from  
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27 11 Hungary, Poland and the Czech Republic, contained the same amounts of I-TFA as the popcorn that we  
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29 12 analysed in 2005. In contrast, the I-TFA in popcorn from Germany, France, and UK was negligible  
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31 13 (Fig. 3 and table 3).  
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35 14 The brand of microwave oven popcorn with the highest concentration of I-TFA (11.6 g I-TFA per 100  
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37 15 g product) found in the Czech Republic in 2005 did not contain I-TFA in 2009. However the same  
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39 16 brand had the highest concentration (7.6g I-TFA per 100 g product) among the microwave oven  
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41 17 popcorn bought in Hungary in 2009.  
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## 47 19 **A high-*trans* menu**

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49 20 In 2001, the potential consumption of I-TFA by eating a high-*trans* menu was 37 g in Denmark, but by  
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51 21 2005, this potential consumption level was reduced to less than 1 g (Fig. 2). In 2005, by contrast, the  
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53 22 potential consumption level via a high-*trans* menu exceeded 20 g in 13 out of the 16 EU-countries,  
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55 23 from which foods were investigated. Hungary, the Czech Republic, and Poland ranked among the  
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4 1 highest, with values around 40 g per menu. A considerable amount of the I-TFA in the menus was  
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6 2 derived from the fast food meal.

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9 3 Figure 3 demonstrates the time trends for I-TFA in the high-*trans* menu in Hungary, the Czech  
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11 4 Republic, Poland, Germany, France, and the UK. In all of the countries, the contribution values  
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13 5 obtained from McDonald's and KFC meals (nuggets and fries) in 2009 were negligible compared to the  
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15 6 values obtained in 2005.

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18 7 In 2009, biscuits, cakes, wafers, and microwave oven popcorn were still high in I-TFA in Eastern EU  
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20 8 countries. In contrast, only small amounts of I-TFA in these same products obtained in Western EU  
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22 9 countries were found.

## 23 24 25 10 26 27 28 11 **DISCUSSION**

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30 12 The data from 2005 show that, despite a mean daily intake of around 1 g I-TFA for the entire  
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32 13 population (as it was in Denmark in 2001), it was still possible to consume 30-40 g I-TFA in a high-  
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34 14 *trans* menu composed of popular foods. Consequently, a low average intake at the population level  
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36 15 does not preclude a very high intake among some subgroups [6]. Following Denmark's 2003  
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38 16 legislation, the I-TFA content of the same menu was reduced to less than 1 g [9-10]. In addition, the  
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40 17 data demonstrate that in 2005 it was possible to eat a menu of popular foods with more than 20 g of I-  
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42 18 TFA in 13 out of 16 EU countries and up to 40 g in Hungary (Fig. 2). Thus far, EU countries (with the  
43  
44 19 exception of Austria and Denmark) rely on food producers to voluntarily reduce the amounts of I-TFA  
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46 20 in foods. The present study demonstrates the difference between Eastern and Western Europe in the  
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48 21 efficiency of this strategy. The overall picture regarding the I-TFA content in fast food,  
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50 22 biscuit/wafers/cookies and microwave oven popcorn in the EU indicates that I-TFA has disappeared  
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52 23 from American-based fast food, such as that from McDonald's and KFC, mainly due to societal  
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4 1 pressure[9,11]. The same decline for biscuits and snacks in Western EU countries were observed. In  
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6 2 Eastern EU countries, however, the amount of I-TFA in these products is still high. We even observed  
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8 3 this difference in products bought at the same retailers in the Eastern and Western EU countries (e.g.  
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10 4 Carrefour).  
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## 16 6 **Limitations of the study**

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18 7 The average daily intake of I-TFA was not measured in subgroups of the population, but instead  
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20 8 inferred from the popularity of fast food from McDonald's and KFC and from the presence of popular  
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22 9 foods with high amounts of I-TFA in large supermarkets. The assumptions are: 1) the analysed brands  
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24 10 of biscuits, cakes, wafers, and microwave oven popcorn were stocked at the supermarkets because they  
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26 11 are sold in considerable amounts; 2) the majority of these foods are regularly bought and consumed by  
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28 12 the same subgroups of consumers; and 3) the findings in the supermarkets in each capital are  
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30 13 representative of the entire country and of adjacent countries in the Eastern and Western Europe.  
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32 14 Another weakness is that only foods were bought in large supermarkets and from two international fast  
33  
34 15 food providers (McDonald's and KFC). The I-TFA content in foods sold by small, privately owned  
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36 16 shops or street vendors was not examined. Fats with high amounts of I-TFA prolong the shelf life of  
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38 17 foods, and it is reasonable to assume that this factor is of even higher importance for small, privately  
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40 18 owned shops than it is for larger supermarkets. The selective pattern of purchasing may thus have led to  
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42 19 an underestimation of the amounts of I-TFA consumed by subgroups of the population.  
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## 51 21 **Implications**

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53 22 An intake of above 5 g of TFA daily is associated with a health risk that can be eliminated more easily  
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55 23 than many other diet-associated health risks. This issue is particularly relevant to low socioeconomic  
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4 1 groups, such as truck and taxi drivers and manual labourers, who, due to other lifestyle factors, already  
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6 2 have an increased risk of coronary heart disease partly due to high prevalence of smoking and poor  
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8 3 diet, including high intake of I-TFA, and metabolic syndrome [12].  
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11 4 In 2012, EU countries, with the exception of Austria and Denmark, legally allow foods with the  
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13 5 maximum concentration of I-TFA in the fat (i.e. 60%) to be sold without any notice as long as the food  
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15 6 is unpackaged (as is the case for restaurants and fast food outlets). If the food is pre-packaged, then the  
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17 7 law requires the presence of I-TFA to be noted only by the term “partially hydrogenated fat” in the list  
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19 8 of ingredients. Most consumers do not appreciate the hazard concealed therein.  
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23 9 Societal pressure on food producers has undoubtedly resulted in a reduction in the population-level  
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25 10 mean intake of I-TFA from 2005 to 2009, especially in Western EU countries [11].  
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28 11 However, this study demonstrated that a high intake of I-TFA is still possible in Eastern EU countries.  
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30 12 This problem will continue as long as popular foods with a high concentration of I-TFA are available.  
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32 13 Even though labelling foods with I-TFA contents may further reduce the mean intake of I-TFA, such  
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35 14 labelling still allows the intake of high amounts of these fatty acids, first because fast food is not  
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37 15 labelled and second because consumers might not pay attention to or understand the labelling [14-15].  
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39 16 A further advantage of a legislative limit on I-TFA content is that it does not require the population to  
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42 17 learn about the health risks of I-TFA or to pay attention to the labelling of food products. It is also  
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44 18 much easier and cheaper to monitor the presence of I-TFA in foods than it is to monitor the actual  
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46 19 intake of I-TFA in at-risk population subgroups.  
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49 20 In EU Austria and Denmark have shown that the health risk that a high intake of I-TFA causes, can be  
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51 21 eliminated for the entire population without any noticeable side effects for consumers. This has the  
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54 22 added advantage of creating a “level playing field” for suppliers. All are equally challenged. All can  
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56 23 profit from experience of successful and rapid adaptation as in Denmark. It remains to be investigated  
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1 to what extent the difference of availability of I-TFA in popular foods between and Eastern and  
2 Western EU countries contributes to the much higher mortality of coronary heart disease in Eastern,  
3 than in Western EU-countries (Fig. 4) [10].

#### 5 **What this paper adds box**

##### 6 WHAT IS ALREADY KNOWN ON THIS TOPIC

7 A daily intake of approximately 5 g of industrial *trans* fatty acids is associated with a 23% increase in  
8 the risk of coronary heart disease.

9 In the EU Austria and Denmark have shown that a high intake of I-TFA can be eliminated by a  
10 legislative ban, without any noticeable side effects for consumers.

##### 12 WHAT THIS STUDY ADDS

13 A decline since 2005 in the amounts I-TFA in popular foods in Western EU countries is observed

14 In Eastern EU countries, however, the amount of I-TFA in these products is, in spite of some reduction,  
15 still high.

16 A low average intake of I-TFA at the population level does not preclude a very high intake among  
17 some subgroups.

18 Most EU countries rely on food producers to voluntarily reduce the amounts I-TFA in foods with  
19 variable results. However, legislation is eminently feasible, and offers a more effective, rapid and  
20 equitable approach.

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4 1 **Contributors:** SS obtained funding. SS and JD were both responsible for the concept design of the  
5  
6 2 study, for collection of food items, registration and labelling. SS and JD produced the first draft of the  
7  
8 3 paper and SS, JD and AA were responsible for critical revision of the manuscript. SS is a guarantor for  
9  
10 4 the study  
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15  
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17  
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19  
20 8 The study funders had no role in study design, in the collection, analysis and interpretation of data; in  
21  
22 9 the writing of the report and in the decision to submit the article for publication. The researchers' were  
23  
24 10 independent from funders. SS is the head of the department which provided resources for the  
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26 11  
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30 12 All authors had full access to all of the data in the study and can take responsibility for the integrity of  
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32 13 the data and the accuracy of the data analysis  
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36  
37 15 **Data sharing:** no additional data available.  
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42 17 **Conflicts of interest:** None of the authors have any relevant conflicts of interest.  
43

44 18 The corresponding author had full access to all the data in the study and has the final responsibility for  
45  
46 19 the decision to submit for publication.  
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48

#### 49 20 **Competing Interest**

50  
51 21 All authors have completed the Unified Competing Interest form at

52 22 [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) (available on request from the corresponding author)

53  
54 23 and declare that none of the authors have relationships with companies that might have  
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1 an interest in the submitted work in the previous 3 years; Their spouses, partners, or  
2 children have no financial relationships that may be relevant to the submitted work; and  
3 (4) None of the authors have non-financial interests that may be relevant to the  
4 submitted work.

5  
6 This study did not require ethics approval  
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For peer review only

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11 **4** Amounts of industrial *trans* fatty acids in 100 g of biscuits/cakes/wafers bought in six EU countries in  
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13 **5** 2005 and in 2009. For both groups of countries (three Eastern EU countries and three Western EU  
14  
15 **6** countries), the products are ranked according to the concentrations of industrially produced *trans* fatty  
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17 **7** acids. Products were only bought if “partially hydrogenated fat” or a similar term was listed among the  
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19 **8** first three ingredients and if the food label indicated that the fat content exceeded 15 g of fat per 100 g.  
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21 **9** Fewer products in Western EU countries fulfilled the inclusion criteria compared with products in  
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23 **10** Eastern EU-countries.  
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34 **14 Figure 2**

35  
36 **15** Amounts of industrial *trans* fatty acids in a high-*trans* menu bought in the various countries in 2005.  
37  
38 **16** For each country, the product with the highest concentration of industrial *trans* fatty acids in each of  
39  
40 **17** the three food categories is shown.  
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46 **19 Figure 3**

47  
48 **20** Time trends for the amounts of industrial *trans* fatty acids in a high-*trans* menu bought in  
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50 **21** three Eastern EU countries in 2005 and 2009 and in three Western EU countries in 2005  
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52 **22** and 2009.  
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4 **1 Figure 4**

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6 2 Trends in coronary heart disease mortality rates, selected OECD countries, 1980-2006.

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9 3 Source: OECD Health Data 2009. The raw mortality data are extracted from the WHO

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11 4 Mortality Database, and age-standardised to the 1980 OECD population. For 2006 to 2009

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13 5 the yearly mortality for Hungary is 228, 215,205 and 204. The corresponding values for

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16 6 Denmark and for OECD-mean have not yet appeared in the OECD Health data 2011.

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**Table 1** Trans fatty acids (TFA) in biscuits, cakes, and wafers bought in 2005 in large supermarkets in the capital of the country. Products were only bought if "partially hydrogenated fat" or a similar term was listed among the first three ingredients and if the food label indicated that the fat content exceeded 15 gram of fat per 100 gram product.

	2005		2009		2005		2009		2005		2009			
	Gram TFA in 100 gram product		Gram TFA in 100 gram product		Gram TFA in 100 gram product		Gram TFA in 100 gram product		Gram TFA in 100 gram product		Gram TFA in 100 gram product			
	Item no.		Item no.		Item no.		Item no.		Item no.		Item no.			
<b>Hungary</b>	10	10.4	93	5.6	<b>Poland</b>	43	12.5	111	6.0	<b>Czech Republic</b>	25	15.3	57	2.3
	19	4.2	88	5.0		2	11.9	85	5.5		11	14.3	64	2.0
	26	3.7	98	2.2		26	11.7	92	5.4		35	14.0	69	2.0
	24	2.1	85	2.2		44	10.8	107	5.5		20	12.9	71	1.9
	33	1.4	97	0.4		1	8.1	91	5.0		36	12.8	66	1.9
	29	1.1	96	<0.2		40	7.4	89	4.3		24	12.7	56	1.6
	32	0.9	91	<0.2		5	6.3	97	3.5		5	11.7	54	0.9
	15	0.9	86	<0.2		24	6.3	114	2.6		21	8.5	55	0.7
	35	0.8	90	<0.2		35	5.7	87	2.6		29	8.2	58	0.5
	34	0.5	83	<0.2		42	5.5	113	2.1		41	7.8	73	0.4
	36	0.5	84	<0.2		33	4.4	109	2.0		31	7.1	76	0.3
	23	0.3	89	<0.2		22	4.3	104	1.7		38	6.3	74	0.3
	8	<0.2	92	<0.2		6	4.0	105	1.4		34	5.3	78	0.3
	9	<0.2	99	<0.2		21	3.9	95	0.9		23	3.8	77	<0.2
	16	<0.2	95	<0.2		23	3.4	110	0.8		40	3.7	70	<0.2
	28	<0.2	87	<0.2		29	2.9	112	0.7		43	1.7	72	<0.2
	30	<0.2	94	<0.2		45	2.8	115	0.5		22	1.6	59	<0.2
	5	<0.2	82	<0.2		36	<0.2	108	<0.2		42	1.4	63	<0.2
	6	<0.2				34	<0.2	106	<0.2		27	1.2	80	<0.2
	11	<0.2				4	<0.2	96	<0.2		28	0.4	53	<0.2
	12	<0.2				37	<0.2	88	<0.2		12	<0.2	75	<0.2
	13	<0.2				25	<0.2	103	<0.2		13	<0.2	68	<0.2
	18	<0.2				38	<0.2	90	<0.2		26	<0.2	79	<0.2
						7	<0.2	94	<0.2		30	<0.2	81	<0.2
						13	<0.2	93	<0.2		32	<0.2	65	<0.2
						3	<0.2	86	<0.2		37	<0.2	60	<0.2
						20	<0.2				39	<0.2	61	<0.2
						27	<0.2				44	<0.2	62	<0.2
						28	<0.2							
						30	<0.2							
						31	<0.2							
						39	<0.2							
Total number of items	23		18		32		26		28		28		28	

Item no. is an internal identification number for each package of biscuits, cakes, and wafers bought in a given country.

**Table 1** Trans fatty acids (TFA) in biscuits, cakes, and wafers bought in 2005 in large supermarkets in the capital of the country. Products were only bought if "partially hydrogenated fat" or a similar term was listed among the first three ingredients and if the food label indicated that the fat content exceeded 15 gram of fat per 100 gram product.

	2005		2009		2005		2009		2005		2009			
	Item no.	Gram TFA in 100 gram product	Item no.	Gram TFA in 100 gram product	Item no.	Gram TFA in 100 gram product	Item no.	Gram TFA in 100 gram product	Item no.	Gram TFA in 100 gram product	Item no.	Gram TFA in 100 gram product		
<b>France</b>	1b	4.8	12	0.7	<b>Germany</b>	8b	6.9	42	0.3	<b>UK</b>	28a	4.5	58	0.2
	22a	4.2	20	0.5		17b	2.6	51	<0.2		4a	1.3	52	0.2
	24a	3.6	13	0.5		4a	1.4	43	<0.2		16a	1.0	56	<0.2
	4a	3.5	15	0.3		13a	1.1	40	<0.2		17a	1.0	54	<0.2
	2a	1.8	16	0.2		4b	0.8	41	<0.2		15a	0.9	51	<0.2
	26a	1.5	17	0.2		3a	0.6	50	<0.2		36a	0.9	57	<0.2
	13a	0.7	21	<0.2		13b	0.4	46	<0.2		7b	0.7	55	<0.2
	3a	0.7	19	<0.2		5a	0.3	48	<0.2		2b	0.7	53	<0.2
	3b	0.7	22	<0.2		12b	0.3	44	<0.2		10a	0.4		
	15a	0.5	23	<0.2		8a	<0.2	47	<0.2		33a	0.4		
	12a	0.3	18	<0.2		15a	<0.2	49	<0.2		32a	0.3		
	5a	<0.2	14	<0.2		1b	<0.2				34a	0.3		
	18a	<0.2				3b	<0.2				3b	0.2		
	2b	<0.2				16b	<0.2				31a	<0.2		
	3c	<0.2				6a	<0.2				13a	<0.2		
	17a	<0.2				7a	<0.2				1a	<0.2		
	23a	<0.2				14a	<0.2				39a	<0.2		
	1a	<0.2				17a	<0.2				5b	<0.2		
	16a	<0.2				6b	<0.2				6b	<0.2		
	21a	<0.2				21b	<0.2				8b	<0.2		
	25a	<0.2				16a	<0.2				9b	<0.2		
	2c	<0.2									29a	<0.2		
	20a	<0.2									23a	<0.2		
	14a	<0.2									11a	<0.2		
	19a	<0.2									12a	<0.2		
	1c	<0.2									2a	<0.2		
	4b	<0.2									38a	<0.2		
											40a	<0.2		
											4b	<0.2		
											5a	<0.2		
											8a	<0.2		
											35a	<0.2		
Number of items	27		12			21		41			33		22	8

Item no. is an internal identification number for each package of biscuits, cakes, and wafers bought in a given country.



Table 2

Amounts of industrial *trans fatty acids* in a high-trans menu bought in the various countries in 2005.

	<b>Gram of TFA in a large serving* of nuggets and French fries</b>	<b>Gram of TFA in 100 gram biscuits, cakes, and wafers</b>	<b>Gram of TFA in 100 gram microwave popcorn</b>	<b>Gram of TFA in a high <i>trans</i> menu</b>
Czech Rep 2005	16.8	15.3	11.6	43.7
Poland 2005	19.8	12.5	10.7	42.3
Hungary 2005	24.1	10.4	7.6	42.1
Bulgaria 2005	22.5	7.9	7.7	38.1
Romania 2005	15.3	3.5	11.8	30.6
France 2005	6.2	4.8	13.8	24.8
Germany 2005	4.9	6.9	12.4	24.2
Portugal 2005	4.0	5.5	13.9	23.4
Spain 2005	5.0	4.6	13.8	23.4
UK 2005	8.2	4.5	10.4	23.1
The Netherlands 2005	5.0	6.7	11.0	22.7
Austria 2005	4.2	8.4	9.4	22.0
Italy 2005	6.0	3.3	11.9	21.2
Sweden 2005	4.8	6.0	5.9	16.7
Finland 2005	5.9	4.6	0.1	10.6
Denmark 2001	10.0	17.0	10.0	37.0
Denmark 2005	0.3	0.3	0.3	0.9

\* A large serving was 171 gram of French fries or wedges and 160 gram of nuggets or hot wings

Table 3

Amounts of industrial *trans fatty acids* in various foods bought in three Eastern EU countries in 2005 and 2009 and in three Western EU countries in 2005 and 2009

	<b>Gram of TFA in a large serving of nuggets and French fries</b>	<b>Gram of TFA in 100 gram biscuits/cakes/wafers</b>	<b>Gram of TFA in 100 gram microwave popcorn</b>	<b>Gram of TFA in a high-trans menu</b>
Hungary 2005	24.1	10.4	7.6	42.1
Czech Rep 2005	14.1	15.3	11.6	41.0
Poland 2005	19.1	12.5	6.7	38.3
Hungary 2009	<1	5.6	6.9	12.5
Czech Rep 2009	<1	2.3	16.8	19.1
Poland 2009	<1	6.0	7.6	13.6
France 2005	6.2	4.8	13.8	24.8
Germany 2005	5.3	6.9	12.4	24.6
UK 2005	8.3	4.5	10.4	23.2
France 2009	<1	<1	<1	<1
Germany 2009	<1	<1	<1	<1
UK 2009	<1	<1	<1	<1

Table 4

Trends in ischemic heart disease mortality rates, selected OECD countries, 1980–2006

	Denmark	Hungary	OECD
1980	261.2	217	171.8
1981	258.4	231.5	170.3
1982	241.3	230.7	166.8
1983	237.9	231	165.2
1984	235.4	223.9	162.0
1985	232.1	225	162.6
1986	226.5	227.5	157.5
1987	221.9	221.5	154.3
1988	211.6	223.5	150.5
1989	204.4	222.8	147.6
1990	201.6	226.6	144.3
1991	187.8	230.2	141.4
1992	181.9	234.6	138.3
1993	180.2	244.2	137.0
1994	158.0	233.1	130.3
1995	157.4	235.4	128.9
1996	136.6	237.8	123.6
1997	130.5	232.2	118.7
1998	120.5	234.2	115.4
1999	117.4	240.9	114.6
2000	106.0	225.4	107.9
2001	106.4	212.9	103.2
2002	93.7	209.3	100.7
2003	87.9	219.7	98.1
2004	80.4	220.6	92.5
2005	73.9	247.5	89.7
2006	67.8	228.5	86.9

Deaths per 100 000

Source: OECD Health Data 2009.

## STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses

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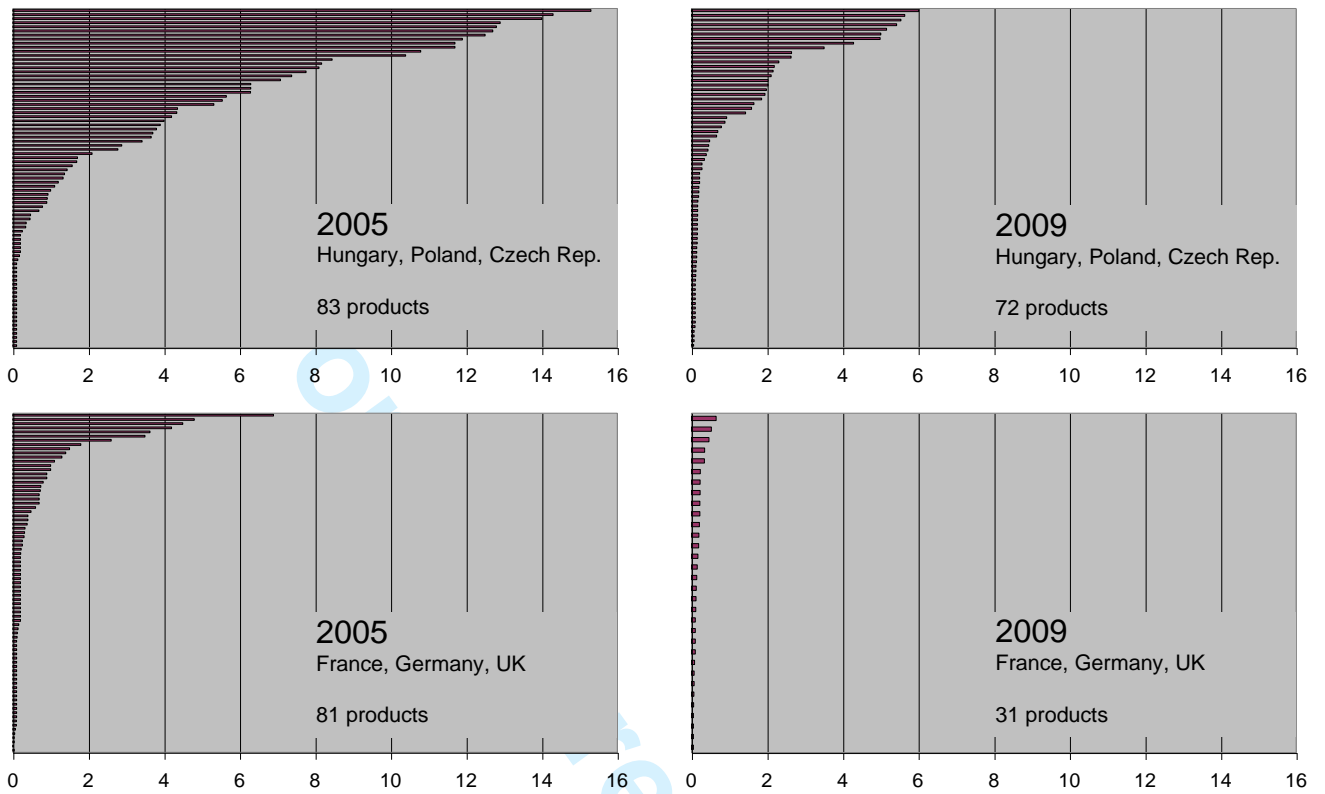
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<b>Results</b>		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
<b>Other information</b>		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

Fig 1

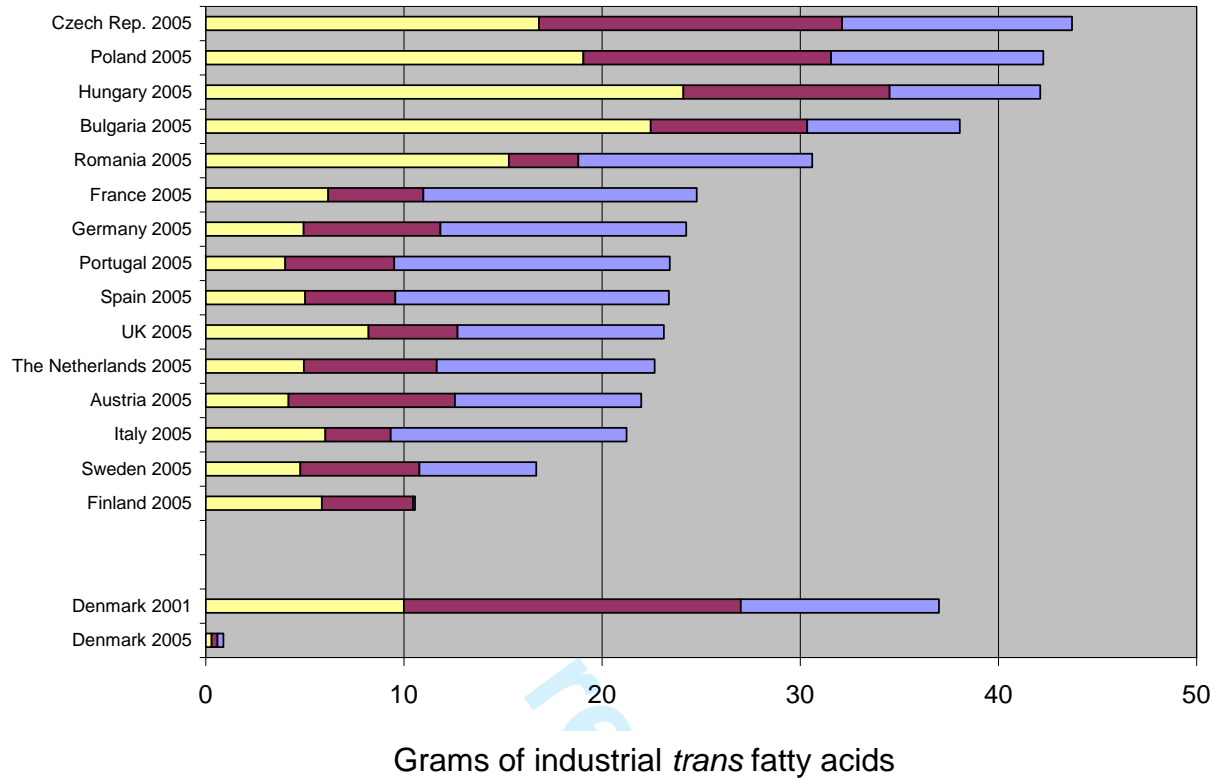


Grams of industrial *trans* fatty acids in 100 g of product

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Fig 2



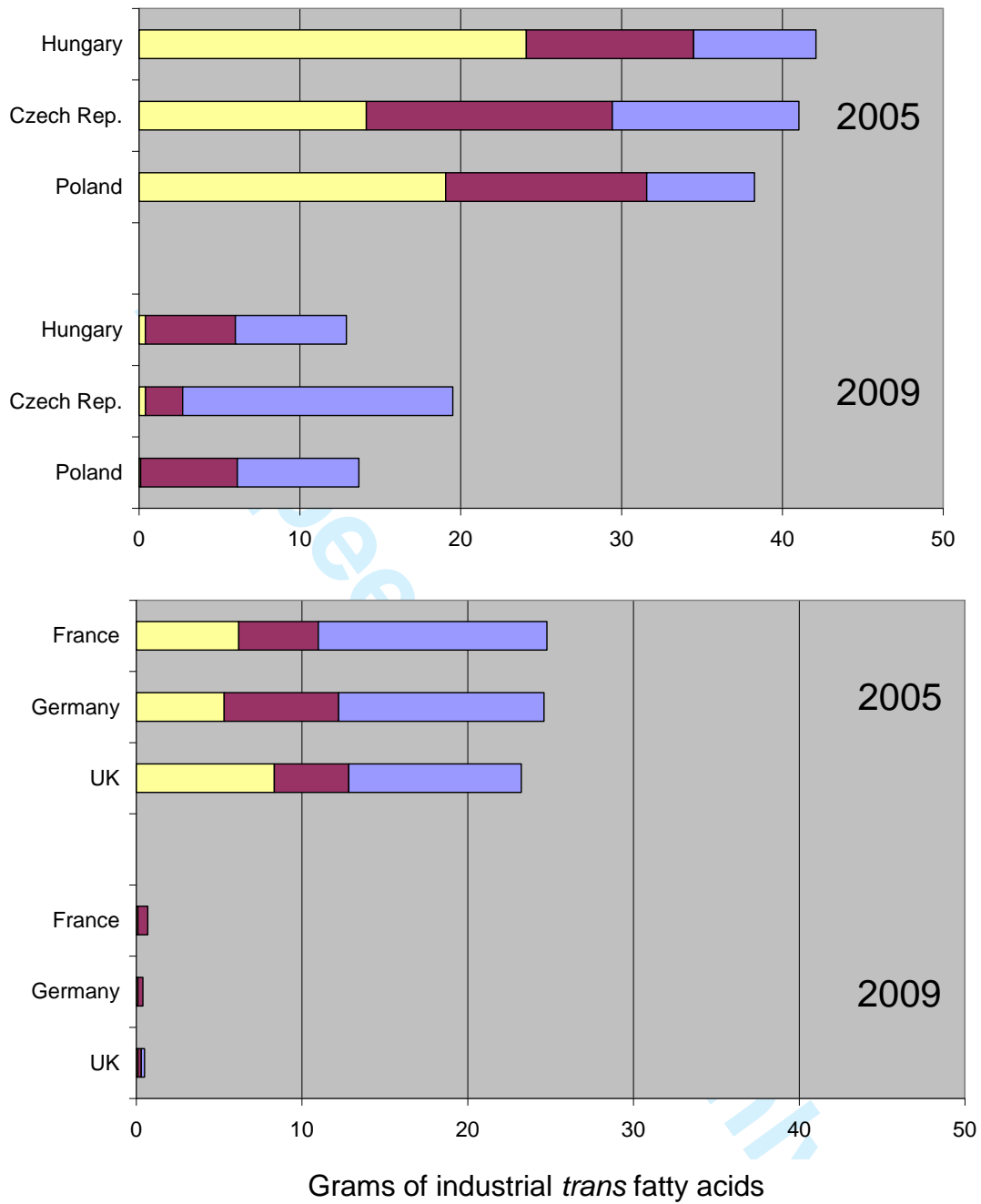
- A large serving of nuggets and French fries
- 100 g biscuits/cakes/wafers
- 100 g microwave popcorn



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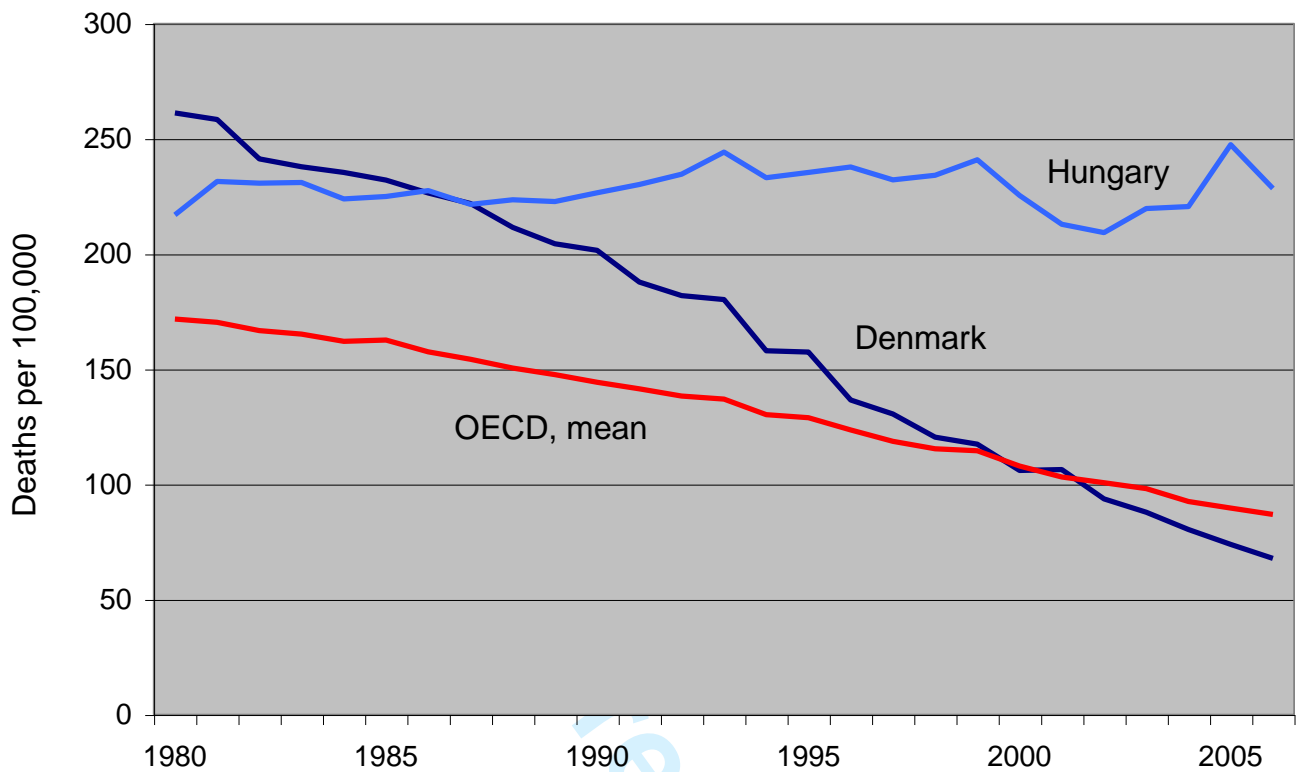
Fig 3



- A large serving of nuggets and French fries
- 100 g biscuits/cakes/wafers
- 100 g microwave popcorn

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Fig 4



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4 Reviewer 1 Comments...

5 Name: S Capewell

6 Position: Chair of Clinical Epidemiology  
7

8  
9 This is an excellent paper with very important messages for public health in  
10 the UK and Europe.  
11

12 I have no major criticisms, apart from: Figure 3 which is currently a  
13 histogram; it needs to be redrawn as a bar chart, to facilitate comparisons  
14 with Figure 2.  
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17 A new figure 3 has been made according to the reviewer's suggestion  
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20  
21 Secondly, I do have a few suggestions to make the paper even better. Mainly by  
22 strengthening or revising specific sentences.  
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25 These are specified below, with suggested changes IN CAPITALS.  
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28 Also, I will endeavour to also send the comments as a Word "Track Changes"  
29 document, which may be MUCH easier to comprehend.  
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32 All numbers refer to line numbers in the pdf document submitted.  
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35 A trans European Union difference in the decline in trans fatty acids in  
36 popular foods - a basket investigation.  
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38

39 ABSTRACT  
40

41 Line 8 Objectives: Trans fatty acids (TFA) are produced when liquid vegetable  
42 oil is industrially hydrogenated to make it solid fat. A daily intake of  
43 approximately 5 g of TFA is associated with a 23%  
44 increase in the risk of CORONARY heart disease. In order to minimize the  
45 intake of TFA some countries  
46 have introduced labelling, while others have introduced legislative limits  
47 on the content of TFA in  
48 food INCLUDING AUSTRIA, DENMARK AND SWITZERLAND. HOWEVER, but most  
49 countries still rely on food producers to voluntarily reduce the TFA content  
50 in food. The  
51 objective of the present study was to investigate the efficiency of these  
52 strategies in the EU.  
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54 Design: The potential consumption of TFA was assessed in a basket  
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4 investigation by analysing the TFA CONTENT in popular  
5 14 foods in 16 EU countries in 2005 and AGAIN in 2009 USING A STANDARD  
6 METHODOLOGY.  
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8 15 Samples: 70 servings of French fries and chicken nuggets, 90 packages of  
9 microwave popcorn, and  
10 16 442 samples of biscuits/cakes/wafers with "partially hydrogenated vegetable  
11 fat" listed on the label  
12  
13 17 high on the list of ingredients were analysed. A "high-trans menu" was  
14 DEFINED AS a large serving of French fries  
15 and nuggets, 100 g of microwave popcorn, and 100 g of biscuits/wafers/cakes.  
16  
17 19 Results: In 2005, a high-trans menu provided above 30 g of TFA in five EU  
18 countries in Eastern  
19 Europe (SPECIFY) and 20–30 g in eight EU countries in Western Europe  
20 (SPECIFY WHICH). In 2009 the values in Hungary, Poland,  
21 and the Czech Republic REMAINED HIGH (between 10 and 20 g), whereas they  
22 were less than 2 g. in Germany,  
23  
24 22 France and the UK,  
25

#### 26 27 Conclusion:

28 In 2009 the content of TFA in popular foods in 1 Western European APPEARS LOW  
29 but not in  
30 Line 2 Eastern European EU countries. THESE FINDINGS suggest that millions of  
31 people in the EU still consume TFA in  
32 3 amounts that SUBSTANTIALLY increase their risk of CORONARY heart disease.  
33 The Austrian, Danish, and Swiss experiences  
34 4 with legally limiting TFA content in human food, demonstrate that this risk  
35 can be eliminated, with no  
36 5 noticeable effect on the availability, price, or quality of food.  
37  
38  
39

#### 40 41 INTRODUCTION

42 Line 2 Trans fatty acids (TFA) in food originate from industrial hardening of  
43 oils and from ruminant sources.  
44 3 Compared to unhydrogenated oils, fats containing industrially produced TFA  
45 are solid at room  
46 4 temperature, have some technical advantages in food processing, and prolong  
47 the shelf life of food. HOWEVER,  
48 5 TFA can constitute up to 60% of the fats in certain foods, whereas ruminant  
49 fat contains at most 6%  
50 6 TFA. A meta-analysis of four large prospective studies found that an intake  
51 of INDUSTRIAL TFA corresponding to  
52 7 2% of the total energy intake (E %) (approximately 5 g/d) was associated  
53 with a 23% increase in the  
54 8 risk of CORONARY heart disease<sup>1</sup>. Several public health organisations have  
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4 therefore recommended that INDUSTRIAL TFA intake  
5 should be lowered as much as possible<sup>2–4</sup>. In 1976, the average intake of  
6 INDUSTRIAL TFA in Western  
7  
8 Europe was 6 g/d. In 1996, this intake had dropped to 2.6 g/d (range 1.2 to  
9 6.7 g/d), corresponding to  
10 11 0.5–2.1 E%<sup>5</sup>. Approximately half of this intake was from ruminant TFA, and  
11 only about 1.3 g was from  
12 industrial TFA, which constitutes a 78% decrease since 1976<sup>5</sup>. Despite a  
13 mean population intake of  
14 approximately 1 g of industrial TFA per day in Denmark in 2001, it was  
15 still possible to consume 20–  
16 14 30 g of TFA in a SINGLE high-trans menu by eating popular food products  
17 such as wafers, microwave popcorn,  
18 15 nuggets, and French fries<sup>4</sup>. Among the 5 million Danes, 10,000–50,000 people  
19 consumed food from  
20 this type of menu several times each week, and got a daily intake of more  
21 than 5 g TFA<sup>4</sup>.  
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29  
30 In 2003, Canada introduced the mandatory labelling of the TFA content in pre-  
31 packaged food. In the  
32 19 same year, Denmark introduced a legislative limit of 2% industrial TFA in  
33 fat used for foods. The  
34 20 European Commission initially opposed this legislation but in MARCH 2007  
35 dropped its infringement  
36 21 proceedings against Denmark because of increased scientific evidence on the  
37 dangers of trans fats<sup>6</sup>.The  
38 22 US introduced mandatory labelling of pre-packaged food in 2006, followed by  
39 legislative limits on  
40 23 TFA in the food served in restaurants in New York City in 2008 and in 2010-  
41 11 in the state of

42  
43  
44  
45 California. In 2009, Austria and Switzerland introduced a legislative ban  
46 similar 1 to the Danish' TO BE FOLLOWED IN 2011 BY ICELAND AND SWEDEN. Of the  
47 2 EU's approximately 500 million inhabitants who consume food that still may  
48 contain high amounts of  
49 3 trans fat, Denmark's and Austria's populations, representing approximately  
50 14 million people, are the  
51 4 exceptions.  
52 5 In 2005, we assessed by a basket investigation the availability of a high-  
53 trans menu (large servings of  
54 6 French fries and nuggets, 100 g of microwave popcorn and 100 g of  
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4 biscuits/wafers/cakes) in 15 EU  
5 7 countries. , and found that, i In spite of a low mean intake, high  
6 concentrations of industrial TFA were still  
7 8 present in many popular foods. Thus, subgroups of the populations could have  
8 an intake that is  
9 9 considerably higher than the recommended upper limit for intake of TFA7. TFA  
10 in foods from  
11 10 international fast food providers was an important contributor to the high  
12 intake in these sub11  
13 populations8. Still in 2009, EU countries (with the exception of Austria and  
14 Denmark) rely on food  
15 12 producers to voluntarily reduce the amounts of TFA in foods. The present  
16 study assess the efficiency of  
17 13 that strategy in three Eastern European countries, Hungary, Poland, and the  
18 Czech Republic, and in  
19 14 three Western European countries, Germany, France, and the UK.  
20  
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24

## 25 METHODS

26 In July 2009 to September 2009, the capitals of Poland, the Czech Republic,  
27 Hungary, Germany,  
28 Line 7 France, and the UK were revisited and the same procedures for the  
29 purchase of food items WERE FOLLOWED. If  
30 8 possible, the same stores were revisited and the same brands were bought.  
31 Altogether, 602 samples of  
32 9 food in EU countries were purchased  
33  
34  
35  
36

## 37 Calculation

38 For comparison, the amounts of TFA in the French fries and the chicken  
39 nuggets were expressed as the  
40 19 amounts in a serving size equivalent to a large serving from McDonald's in  
41 the US: . The serving sizes were 171 g of French fries and 160 g of chicken  
42 nuggets.  
43  
44  
45

## 46 RESULTS

47 Line 2

48 Biscuits, cakes, and wafers

49 3 Figure 1 presents data from the products bought in the six EU countries in  
50 2005 and 2009. The  
51 4 products are ranked according to TFA content and the combined values for the  
52 three Eastern EU  
53 5 countries and for the three Western EU countries are given separately.  
54 IN 2005, THE highest TFA contents (10–  
55 6 15 g) in single 100 g servings were found in Hungary, Poland, and the Czech  
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4 Republic. In 2005 in

5 7 France, Germany, and the UK, the TFA contents were lower but still  
6 considerable (4–7 g). AVERAGING 5G EXCLUDING ONE OUTLIER

7  
8 In 2009 biscuits, cakes, and wafers in the three Eastern EU countries  
9 contained a smaller, but still

10 substantial, amount of TFA (4–6 g in Figure 3). In contrast, the TFA content  
11 in products in the three Western EU

12 countries was minimal (< 1 g). The same pattern was observed in each of the  
13 countries.  
14  
15

16  
17  
18 Fast food

19 Line 13

20 In 2005, the TFA content of the McDonald's servings in EU varied from less  
21 than 1 g in Copenhagen

22 14 to 7 g in London, UK. For KFC servings, there were even larger differences  
23 between the countries,

24 15 ranging from less than 1 g in Germany to 24 g in Hungary. 15 percent of the  
25 54 fast food servings

26 16 contained more than 10 g per serving, and 50% contained between 5 and 10  
27 g8. (Figure 2)

28  
29  
30  
31 In 2009, each of the 12 fast food menus, which were collected FRANCE,  
32 GERMANY AND THE UK in the same locations as in 2005,

33 18 contained less than 1 g of TFA per serving (Figure 3).

34 19

35 20

36  
37 Popcorn

38 Line 21 The highest TFA content in a single 100 g serving of microwave oven  
39 popcorn bought in each country IN 2005

40 22 is presented in the data given for the TFA content in the high-trans menu  
41 for that country (Fig. 2), 6-12g

42  
43  
44 In 2009, the microwave oven popcorn samples with the highest 1 amounts of TFA,  
45 which were from

46 2 Hungary, Poland and the Czech Republic, contained the same similar amounts  
47 of TFA as the popcorn that we

48 3 analysed in 2005, 8-16g. In contrast, the TFA in popcorn from Germany,  
49 France, and UK in 2005 (10-13g) was negligible by 2009 (Fig. 3).

50 5

51 6.  
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55 A high-trans menu

56 Line 7 In 2001, the potential consumption of TFA by eating a high-trans menu  
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4 was 37 g in Denmark, but by  
5 8 2005, this potential consumption level was reduced to less than 1 g (Fig.  
6 2). In 2005, by contrast, the  
7 9 potential consumption level via a high-trans menu exceeded 20 g in 13 out of  
8 the 16 EU-countries,  
9 10 from which foods were investigated. Hungary, the Czech Republic, and Poland  
10 ranked among the  
11 11 highest, with values being around 40 g per menu. A considerable amount of  
12 the TFA in the menus was  
13 12 derived from the fast food meal.  
14 13 Figure 3 demonstrates the time trends for TFA in the high-trans menu in  
15 Hungary, the Czech Republic,  
16 14 Poland, Germany, France, and the UK. In all of the countries, the  
17 contribution values obtained from  
18 15 McDonald's and KFC meals (NUGGETS AND FRIES) in 2009 were negligible  
19 compared to the values obtained in 2005.  
20 16 In 2009, biscuits, cakes, wafers, and microwave oven popcorn were still  
21 high in TFA in Eastern EU  
22 17 countries. In contrast, only small amounts of TFA in THESE SAME products  
23 obtained in Western EU countries  
24 18 were found.  
25 19

### 33 Implications

34 7 An intake of above 5 g of TFA daily is associated with a health risk that  
35 can be eliminated more easily  
36 8 than many other diet-associated health risks. This issue is particularly  
37 relevant to low-income groups  
38 9 such as taxi and truck drivers AND MANUAL LABOURERS who, due to other  
39 lifestyle factors, already have an increased risk of CORONARY HEART DISEASE  
40 10 and who may also more frequently eat foods with a high TFA content.  
41 11 In 2011, EU countries, with the exception of Austria and Denmark, legally  
42 allow foods with the  
43 12 maximum concentration of TFA in the fat (i.e. 60%) to be sold without any  
44 notice as long as the food is  
45 13 unpackaged (as is the case for restaurants and fast food outlets). If the  
46 food is pre-packaged, then the  
47 14 law requires the presence of TFA to be noted only by the term "partially  
48 hydrogenated fat" in the list of  
49 15 ingredients. MOST CONSUMERS DO NOT APPRECIATE THE HAZARD CONCEALED  
50 THEREIN. (REF)  
51 16 Societal pressure on food producers has undoubtedly resulted in a reduction  
52 in the population-level

1  
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3  
4 17 mean intake of TFA from 2005 to 2009, especially in Western EU countries.  
5 (ref)

6  
7 18 However, this study demonstrated that a high intake of TFA is still  
8 possible in Eastern EU countries.

9  
10 19 This problem will continue as long as popular foods with a high  
11 concentration of TFA are available.

12 20 Even though labelling foods with TFA contents may further reduce the mean  
13 intake of TFA, such

14 21 labelling still allows the intake of high amounts of these fatty acids,  
15 first because fast food is not

16 22 labelled and second because consumers might not pay attention to the  
17 labelling OR UNDERSTAND.

18  
19 A further advantage of a legislative limit on TFA content is that it does 1  
20 not require the population to

21 2 learn about the health risks of TFA or to pay attention to the labelling of  
22 food products. It is also MUCH easier

23 3 and cheaper to monitor the presence of TFA in foods than it is to monitor  
24 the actual intake of TFA in

25 4 at-risk population subgroups.

26  
27 5 Austria and Denmark have shown that the health risk that a high intake of  
28 industrially produced trans

29 6 fatty acids causes can be eliminated for the entire population without any  
30 noticeable side effects for

31 7 consumers.

32  
33 THIS HAS THE ADDED ADVANTAGE OF CREATING A "LEVEL PLAYING FIELD" FOR  
34 SUPPLIERS. ALL ARE EQUALLY CHALLENGED. ALL CAN PROFIT FROM EXPERIENCE OF  
35 SUCCESSFUL AND RAPID ADAPTATION AS IN DENMARK. (refs) It remains to be

36  
37 investigated to what extent the difference of availability of TFA in popular  
38 8 foods between and Eastern and Western EU countries contributes to the much  
39 higher CHD mortality

40 9 in CENTRAL EUROPE, than in Western EU-countries (Fig. 4) 10.

41 10

42  
43 11 What this paper adds box

44 12 WHAT IS ALREADY KNOWN ON THIS TOPIC

45 13 A daily intake of approximately 5 g of industrially produced trans fatty  
46 acids (TFA) is associated with

47 14 a 23% increase in the risk of CORONARY heart disease.

48 15 In the EU Austria and Denmark have shown that a high intake of TFA can be  
49 eliminated by a

50 16 legislative ban, without any noticeable side effects for consumers.

51 17

52 18 WHAT THIS STUDY ADDS

53 19

1  
2  
3  
4 A DECLINE SINCE 2005 IN THE AMOUNTS TFA IN POPULAR FOODS IN WESTERN EU  
5 COUNTRIES IS OBSERVED.  
6  
7 23 IN EASTERN EU COUNTRIES, HOWEVER, THE AMOUNT OF TFA IN THESE PRODUCTS IS  
8 STILL HIGH  
9

10 A low average intake TFA at the population level does not preclude a very  
11 high intake among some  
12 20 subgroups.

13  
14 21 Most EU countries rely on food producers to voluntarily reduce the amounts  
15 TFA in foods, WITH VARIABLE RESULTS.  
16

17 22  
18 However, legislation is eminently feasible, and offers a more effective, rapid  
19 and equitable approach.  
20

21  
22 Fig 1

23 Line 32 Grams of industrially produced trans fatty acids in 100 g of  
24 product  
25

26  
27 We need some figures for 2009  
28

29  
30 Figure 3

31 HISTOGRAM LOOKS ODD. IT NEEDS TO BE CHANGED INTO A BAR CHART, TO FACILITATE  
32 COMPARISON WITH FIGURE 2

33 [The figure has been changed as suggested](#)  
34

35  
36 Figure 4

37 HUNGARY TRENDS LOOK ODD. MORTALITY FALLS ARE NOW OCCURRING THERE TOO.

38 [We have added the new available figures for 2007, 2008, and 2009](#)  
39

40  
41 [In conclusion we have followed all of the suggestions from this reviewer and we appreciate his](#)  
42 [thorough work with our manuscript](#)  
43  
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50  
51 [Reviewer 2 Comments...](#)

52 Name: Andrew Odegaard PhD, MPH

53 Position: Research Associate

54 COMMENTS FOR THE AUTHOR  
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4 The authors have carried out what appears to be a case study that aims to  
5 examine the efficiency of relying on producers to voluntarily reduce TFA in  
6 foods with historically high TFA content. Indeed, the authors have an extensive  
7 and noteworthy background on this public health area.  
8  
9

10 They found major fast food corporations seem to be self-regulating overall in  
11 Europe, biscuits/crackers makers to an extent in Eastern and certainly in  
12 Western Europe, where microwave popcorn is self-regulated in Western, but not  
13 Eastern Europe. Essentially, 4.5 of the possible 6 areas of possible TFA  
14 reduction occurred with self-regulation. (those 1.5 areas being only a partial  
15 reduction in TFA in biscuits/crackers and no evident change in popcorn in  
16 Eastern EU).  
17  
18  
19

20 They also report that legislation worked in Denmark to essentially eliminate TFA.  
21  
22

23 This work is certainly original in that it provides a snap shot, to some extent,  
24 on TFA in foods with traditional high levels of TFA, and is probably most  
25 relevant to policy makers, since that is what the author's are arguing for.  
26  
27

28 That said, there are a number of points that could be sharpened to improve this  
29 as a scientific research article as it currently reads as more of a hybrid of  
30 original research and advocacy paper or editorial.  
31  
32

33 I've provided general and specific comments below that I hope are helpful.  
34  
35

36 General

37 The focus should emphasize "industrial" TFA throughout the paper.  
38  
39

40 Some readers may quibble with the use of "ischemic" instead of Coronary Heart  
41 Disease, but this is immaterial if defined specifically using and ICD code for  
42 example.  
43  
44

45 [We have replaced the word ischemic with coronary heart disease as also suggested by](#)  
46 [reviewer 1](#)  
47

48 Given the study design and approach- was the follow up assessment in 2009  
49 planned in 2004/5 or was this opportunistic use of data? Either way, it provides  
50 interesting results from a number of perspectives.  
51  
52

53 I think the title may be misleading – the aim seems to have been to assess a  
54 high-TFA menu based on items from three different avenues of processed foods  
55 that are likely widely available. There is no evidence provided that these are  
56 actually popular items or the per capita consumption is high.  
57  
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5 We assume the popularity of these products because they were stocked at the supermarkets.  
6 They are only stocked there because they are sold in considerable amounts. This is mentioned  
7 in the manuscript.  
8

9 The competition between food producers of having their products on the shelves in large  
10 supermarkets is fierce. Only products with a sufficient turnover are allowed to be there.  
11

12  
13 The popularity of foods from McDonald and KFC in large cities is inferred from the same  
14 argumentation.  
15

16  
17 As well, the abstract conclusion could use more nuance- the fast food reported  
18 in Eastern EU was self regulated according to your results.  
19

20  
21 We have modified the conclusion by adding the sentence "in spite of some reduction" (in  
22 Eastern Europe)  
23

24 Introduction:

25  
26  
27 -The sentence beginning in line 5 needs a reference for the values provided.

28 We have provided the following reference: Wahle KWJ, James WPT. Isomeric fatty acids and  
29 human health.

30 Eur J Clin Nutr 1993; 47: 828-39.  
31

32  
33 -An estimate of 0.2-1.0% of the Danish population eats this way according to  
34 data provided. Is this a public health issue if similar percentages of these  
35 other countries are doing the same? An approach aiming to show this would  
36 strengthen the article for the audience. This also relates to the title (popular  
37 foods).  
38

39  
40 We have in line 17 page 4 added the sentence: "Generalizing to the population in the EU, this  
41 corresponds to 1-5 million people"  
42

43  
44 -Are readers going to be confused on what a "basket investigation" is? If there  
45 is an actual definition- this essentially seems to be a case study  
46

47  
48 We have now replaced the word basket with the words "market basket" In PubMed.com the  
49 search term "market basket" generates 20 titles using the term in the title and 155 papers  
50 using the term in the text. Most of the papers deal with the content of toxic components in  
51 foods.  
52

53 Reviewer 2 finds the study to be a case study. We report however 600 cases, which are the  
54 number of foods, analysed for TFA  
55

56  
57 Pg 5 line 11- Earlier it was noted that Switzerland also had introduced a  
58  
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4 legislative ban on TFA, which one is it?  
5  
6

7 The sentence in the paper reads: "Still in 2009, EU countries (with the exception of Austria and  
8 Denmark) rely on food producers to voluntarily reduce the amounts of I-TFA in foods."

9 Switzerland is not an EU country.

10 The legislative ban in Switzerland is similar to the legislative ban in Denmark and is mentioned  
11 in the text.  
12  
13

#### 14 15 16 Methods

17  
18 How were the countries chosen- at random or based on available data?  
19

20 As mentioned in the text: "The cities included were partly determined by visits taken by the  
21 authors and their colleagues for other purposes, and these visits were supplemented by  
22 arranged visits by two of the authors (SS, JD)."

23 In 2005 (fig 2) we intended to include as many EU countries as economically feasible.

24 In 2009 we revisited the 3 eastern EU-countries that had the highest values for the high *trans*-  
25 menu: Czech Republic, Poland and Hungary and decided to compare with 3 large western EU  
26 countries: Germany, France, and UK.  
27  
28  
29

30 Is there any estimate to the prevalence of said "high density" TFA foods in the  
31 supermarkets, for example, what % of microwave popcorn was in this range?  
32  
33

34 We did not count the total number of different brands of micro wave popcorn or of biscuits. We  
35 used the inclusion criteria as given in the text: "Microwave oven popcorn and  
36 biscuits/cakes/wafers were bought if "partially hydrogenated fat" or a similar term was listed  
37 among the first three ingredients and if the food label indicated that the fat content exceeded  
38 15 g of fat per 100 g."  
39  
40  
41

42 Is there any data on the frequency of consumption of these popular products?  
43

44 Not to our knowledge. As already mentioned we rely on the assumption that when the  
45 products are present in large supermarkets, they have a considerable turnover.

46 We have considered using the term "availability of food with high content of trans fatty acids".  
47 However this term does not reflect that the foods were bought only in large supermarkets.  
48  
49  
50

#### 51 52 Results

53 Were fewer products purchased in Western Europe due to availability? Or what was  
54 the reason there is the large sample difference?  
55  
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4 In Western Europe we were in 2009 not able to find the same number of foods that fulfilled the  
5 inclusion criteria: "Microwave oven popcorn and biscuits/cakes/wafers were bought if "partially  
6 hydrogenated fat" or a similar term was listed among the first three ingredients and if the food  
7 label indicated that the fat content exceeded 15 g of fat per 100 g."

8  
9  
10 The number of different brands was probably more or less the same, but in Western Europe  
11 most of them were in 2009 not any longer labelled with the term "partially hydrogenated fat"  
12 or a similar and when they were, the products contained only small amounts of trans fat.

13  
14 In the legend to fig 1 we have added the following sentences: "Products were only bought if  
15 "partially hydrogenated fat" or a similar term was listed among the first three ingredients and  
16 if the food label indicated that the fat content exceeded 15 g of fat per 100 g". Fewer products  
17 in Western EU countries fulfilled in 2009 the inclusion criteria compared with the situation in  
18 Eastern EU-countries.  
19  
20  
21

### 22 23 Limits

24 Line 4, pg 10- the selective pattern of purchasing could also have led to an  
25 overestimate of amounts of TFA in subgroups  
26  
27

28 Our argumentation supports an underestimation.  
29

### 30 31 Implications

32 A reference should be provided on the point related to "low income groups", and  
33 other lifestyle factors.

34 We wrote: low-income groups.. who due to other lifestyle factors, already have an increased  
35 risk of coronary heart disease and who may also more frequently eat foods with a high I-TFA  
36 content  
37

38 We have added the following reference: Gill PE and Wijk K Case study of a healthy eating  
39 intervention for Swedish lorry drivers Health Education Research 2004 vol. 19 no.3:306-315  
40  
41

42 Same with the statement regarding regulation of TFA in the EU.

43 We have added the following reference: Legislation relating to the level of industrially  
44 produced trans fatty acids in food p45-49 in: The influence of trans fatty acids on health-  
45 fourth edition 2004, WWW.meraadet.dk  
46  
47

48 Again, with the statement beginning with "societal pressure on....".

49 We have added the following reference: Katan MB Regulation of trans fats: The Gap, the  
50 Polder, and McDonald's French fries. Atherosclerosis Supplements 7 (2006) 69-71  
51  
52

53 Again, citing the effectiveness or how non-effective labeling actually is for  
54 the consumer.

55 We have added 2 references  
56  
57  
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4 Consumers find food labelling confusing:

5 <http://www.guardian.co.uk/money/2009/may/07/food-drink-health-labels>  
6  
7

8 Borra S. Consumer perspectives on food labels. *Am J Clin Nutr.* 2006 May;83(5):1235S.  
9

10 The ecological data from Denmark on overall IHD(CHD) rates strengthen this  
11 discussion and paper, but mention of other factors that may play into this  
12 decrease is appropriate. As well, if similar data is available from Austria.  
13 Certainly, providing data from all the countries noted in this study would be  
14 best, as well as discussion of the potential "ecological fallacy".  
15  
16

17  
18 With our last sentence in the paper we mention that Trans fatty acids may play a role in the  
19 difference in mortality. Our study does not deal with other and more conventional risk factors  
20 such as smoking , hypertension.  
21  
22

23 By only depicting Hungary and Denmark and the mean for all OECD countries we find the  
24 figure much less complicated compared with a figure that have values for all 6 countries.  
25  
26

27 Due to space constraint we have not dealt with ecological inference fallacy  
28

29 Overall, I think more balance could be added to this discussion- this paper  
30 reads more like an advocacy paper or editorial with some general data. Further  
31 discussion on other reasons that self-regulation by producers works in some  
32 instances, but not all and reasons why different sectors of food producers are  
33 slower to change in the Eastern EU, and so on. Essentially, the authors would  
34 much better persuade the audience of the need for legislation in Eastern EU (and  
35 globally?) by using this approach, in this reviewers mind.  
36  
37  
38

39  
40 PRIVATE COMMENTS FOR THE EDITOR:

41 I'm not real sure what to think of this paper. The authors have provided some  
42 interesting data, which actually could be interpreted that self-regulation works  
43 in some instances, yet the focus, and it seems a bit hasty, doesn't seem to  
44 actualize this and the paper doesn't provide the necessary details, or nuance to  
45 make this seem like a scientific study. Would an observational study that  
46 provided this level of opaqueness even be reviewed? These comments are coming  
47 from a researcher who ardently believes reducing and eliminating TFA from the  
48 food supply and reducing intake of the foods it is historically common in is a  
49 significant public health issue.  
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