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Deposited on: 1 July 2020

UNDERSTANDING THE COMPLEXITIES OF PREVALENCE OF TRANS FAT AND ITS CONTROL IN FOOD SUPPLY IN PAKISTAN

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Keywords: Trans Fat, NCDs, Regulatory Control

AUTHOR CONTRIBUTIONS

ID JCH-SS-20-0242

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Author role in various phases of manuscript preparation is given as below:

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Abstract

Pakistan is among the nations with a high intake of Trans Fatty Acids (TFAs), a major dietary risk factor of noncommunicable diseases (NCDs). Efforts are underway in the country to eliminate industrially-produced TFAs from the food supply in keeping with the priority targets of the World Health Organization (WHO) for 2019-2023. We reviewed the TFA content reported in industrially produced foods and discuss the regulatory landscape for TFAs, to facilitate the required policy changes in Pakistan and ultimately eliminate the TFA burden from industrial food products. The study components include review of published research and product labels as well as review of prevailing food regulations for TFA-related information. A set of recommendations was also prepared to eliminate TFAs from Pakistan after national consultation workshops conducted in year 2019. Vanaspati ghee (partially hydrogenated vegetable oil), bakery shortening, hard margarines and fat spreads are identified as the major sources of TFAs. Federal and provincial food authorities have recently established the limits for TFAs in few products; however, the TFA regulations are insufficient and not in line with global best practices. This study informs a comprehensive national strategy for TFA elimination based on knowledge of TFA prevalence associated regulatory control. We recommend to: (1) promote actions towards replacement of traditional vanaspati ghee/bakery fats with healthier alternatives; (2) develop and implement best regulatory practices in line with WHO recommendations; (3) amend food labeling laws so that clear information will be provided to inform consumers healthy food choices.

1. INTRODUCTION

“A world free of the avoidable burden of noncommunicable diseases” is the vision stated in the Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020.¹ NCDs are a major cause of both morbidity and mortality, accounting for 71% (41 million) of the 57 million global deaths in 2016. In Pakistan, 58% of deaths occurred due to NCDs in 2016, with 25% of these deaths being considered premature, i.e., between the age of 30-70 years.² These early deaths lead to a decline in the socioeconomic condition of the family of the deceased and thereby affects health, education, and wellbeing of these individuals.³

Large population-based studies on the prevalence of NCDs in Pakistan are lacking; however, smaller surveys have shed light on the burden they pose. Per 2013 estimates, the numbers of individuals affected by these conditions are staggering. More than 40 million (of the total population of 182 million) individuals in Pakistan suffer from high blood pressure, whereas 32 million suffer from heart disease, 24 million from obesity, 18 million from high cholesterol levels, and 8 million from diabetes.⁴ Among major NCDs, cardiovascular diseases are the leading cause of mortality (29% in 2016). Modifiable risk factors, such as physical inactivity, tobacco use, harmful use of alcohol, and high dietary intake of sugar, salt, saturated and TFA are major causes of cardiovascular diseases. Despite the fact that there exist strong association of high intake of dietary factors with increased NCD risk, the salt intake by Pakistani population (10 g/person/day) is double of the recommended value.² A recent survey revealed that more than one third of the population was given dietary advice by doctors to reduce salt (36.7%) and fat (40.2%) in the diet.⁵

Industrially-produced TFA have no known health benefits, but increased intake of TFA (>1% of total energy intake) is associated with an increased risk of coronary heart disease events and mortality. Globally, industrially produced TFA causes an estimated 540,000 deaths each year.⁶ WHO therefore recommends TFA daily intake less than 1% of total daily energy or <2% of total fat in all fats, oils and food products. However it is alarming that TFA intake data based on Bayesian hierarchical imputation model for countries under the service area of the WHO Regional Office for the Eastern Mediterranean shows that these have highest per capita consumption of TFA in the world. Egypt led the list, followed by Pakistan.⁷ This high intake of TFA in Pakistan could be attributed to a paradigm shift of fat consumption pattern in Pakistan from costly dairy based desi ghee to a lot cheaper partially hydrogenated vegetable ghee over the decades.⁸ This change has now become integral part of daily diet of population under the influence of industrial evolution of vegetable fats having similar quality attributes to Desi ghee. Moreover high intake of indigenous fried foodstuff and commercial bakery products carrying fat rich in TFA as an ingredient are the other factors responsible for high TFA intake in Pakistan.

Thus elimination of industrially produced TFA is achievable through two policy options recommended by WHO i.e. ban on partially hydrogenated fat or limit of TFA <2% of total fat in all fats and food products. During the past decade, several countries have virtually eliminated industrially produced TFA from the food supply through implementation of systematic policy actions and monitoring programs.⁹ The REPLACE package issued by WHO in May 2018 serves as a roadmap for countries to implement actions to reduce and eliminate industrially-produced TFA, and outlines six strategic action areas to support the prompt, complete, and sustained elimination of industrially-produced TFA from the food supply.¹⁰

In order to facilitate the required policy changes in Pakistan and ultimately eliminate the TFA burden from industrial food products, as a first step there is a need for in depth analysis of the regulatory landscape for TFAs and to review the TFA content reported in industrially produced foods. Therefore study components include review of published research for TFA content in fats and food products as well as review of prevailing food regulations for TFA-related information. A set of recommendations on elimination of TFAs from Pakistan, based on national consultation exercises has also been compiled after national consultation workshops conducted in year 2019.

2. METHODS

This review includes access and compilation of data on 1) fats and oils trade data, 2) published research on prevalence of TFA in fat products, 3) published research on TFA content in industrially produced diets in Pakistan, 4) TFA content on food products label, 5) analysis of regulatory landscape for TFA control in the country. A set of recommendations based on national consultation for elimination of TFA from Pakistan in line with the WHO REPLACE guidelines was also compiled.

2.1. Collection of trade data

Information was gathered and reviewed for the commodities being the potential source of TFA e.g. hydrogenated fats, oils, and margarines. Import data for each tariff code, carrying information on total product value by country of origin for the last five years (2013-18) was retrieved from Federal Board of Revenue (FBR) database.¹¹

2.2. Secondary Data Review on TFA Prevalence in Pakistani Food Supply

A review of secondary data was conducted for determination of TFA content in Pakistani diet. Original articles were retrieved and judged for their quality. The acceptance criterion for quality of research publications was that they took into account Pakistani fat and oil products and industrially produced diets, in peer-reviewed journals during last 20 years. The articles were collected per acceptance criteria, and data regarding content of TFA in Pakistani fat and oil products as well as food products were retrieved and reviewed.

2.3. Nutrition Label Data for Food Products

Nutrition data for food products were retrieved directly from the nutrition fact table printed on the packages' rear or side panel. Supermarkets in Karachi 15 in number having maximum number of local food products on sale were visited to retrieve products' label data on TFA. A number of local stores were also visited to review products. Both the list of ingredients and nutrition fact table given on the packaging were thoroughly reviewed for possible TFA sources and contents in all food products with fats present on their ingredients list. Data were retrieved and analyzed for appropriateness with respect to national and global labeling requirements on TFA i.e. mention on nutrition fact table and content thereof with reference to fat type mentioned in ingredients list.

2.4. Review of National, Provincial, and Regional Regulations on TFA

National Standards, Provincial and Regional Food Regulations were accessed and reviewed for their coverage of TFA in these regulations.

2.5. Preparation of a set of recommendations for TFA elimination

A national multisectoral workshop was conducted on “Consultation on Assessment of TFAs (NCD related Diet risk factors) intake and content in Foods” in April 2019 in Islamabad. Stakeholders from various sectors, i.e., health, education, regulatory bodies, academia and WHO actively participated in developing a consensus on monitoring and regulatory framework/measures for TFA elimination in Pakistan. Steps to harmonize food standards on TFA in the country were also identified. A set of recommendations on these aspects of TFA elimination from Pakistan has been reported in the text. This is in line to strategic actions described in WHO’s REPLACE package, thus can act as way forward for other nations from Middle East and South Asia having dietary pattern in resemblance to Pakistan.

3. RESULTS

3.1. EDIBLE OIL AND VANASPATI GHEE TRADE IN PAKISTAN

The edible oil market segment comprises blended (mix of various oils) and pure oil. Pure oil is comparatively more expensive than blended oil which is the preferred choice of consumers in terms of cooking. In 2017, the Pakistani edible oil industry registered volumetric sales of around 4 million tons (translating into a market size of over 500 billion Pak Rupees. Given the demographic profile of the country, vanaspati ghee accounts for approximately 70% of the market while cooking oil contributes 30% of sales. Around 65% of the vegetable oil usage in country both in domestic and industrial use has been attributed to palm oil compared with 35% for other oil types, i.e., soybean, corn, canola, etc. Around 2.5 million tons of edible oil is consumed by retail customers while industrial sales account for the remaining 1.5 million tons. Current per capita consumption level of Pakistan stands at 23 kg/year compared with the global

average of 28 kg/year (2015-16). Local production of edible oil (cotton seed/rape seed/sunflower seed/canola oil) was reported at 10% of the total demand. The rest of the demand is being fulfilled by import of oils. Palm oil is the major raw material, followed by soybean, sunflower, and canola.¹² Analysis of the country's import data shows that value of imported hydrogenated fats, oils, and margarines remains <1% of total value of fats and oils being imported in Pakistan.¹⁰

3.2. PREVALENCE OF TFA IN FOOD SUPPLY

The research work carried out on TFA level has been reviewed under two sections 1) fat and oil products 2) industrially produced foods.

3.2.1. Trans Fatty Acids in fats and oil products

During the last two decades, a number of studies have been conducted to determine TFA content in fat and oil products available for Pakistani consumers. The TFA content reported in these studies are presented in Table 1.

A study was carried out by Bhangar and Farooq in 2004 on fatty acid composition and TFA contents in oil and ghee products marketed in Pakistan. Thirty-four vanaspati ghee, 11 shortenings, and 11 margarines were analyzed. It was revealed that a group of ghee samples with a high level of palmitic acid (>40%) and low level of stearic acid (<8%) carried lower TFA content, i.e., 14.24% than another group of ghee samples with a low level of palmitic acid (<40%) and high level of stearic acid (>8%). The last mentioned group of ghee samples had a TFA level of 34.36%. Only one sample out of thirty four ghee samples had <1% TFA. Industrial shortenings were noted as containing high TFA values, i.e., 7.30–31.70%. The contents of TFA in

margarines were also analyzed, and it was noted that popular table margarines carried a low level of TFA, e.g., 1.60% whereas some samples of margarine brands had high TFA values up to 23.10%.¹³

A study was conducted to analyze butter and margarine samples (ten each) for their TFA content. These samples were collected from different bakers, confectioners, and retail outlets from Hyderabad (Sindh) and Faisalabad (Punjab) in 2006, on the basis of their popularity. The chemical analysis showed that margarine samples carried TFA content in a broad range, i.e., 2.5 to 21.10%, whereas in butter samples TFA level was found less than 5.00%. The detailed investigation of type of margarine samples to their TFA level revealed that the group of hard-textured bakery margarines contained higher TFA contents (average 13.10%) than the soft-type table margarines (average 3.51% of TFA). In Pakistan, it has been observed that margarines are usually prepared from partially hydrogenated vegetable oils which yield a high level of TFA in finished goods.¹⁴

Consequently, a study carried out to analyze margarine samples shed a clear light on industrial practices in place to manufacture margarine in Pakistan. Around ten samples of popular margarine brands available in Hyderabad were investigated by Kandhro et al. (2008). The authors reported that palmitic acid was dominantly present in all margarine samples at the level of 16.90 to 33.80%. This indicates that palm oil is being used abundantly as raw material in margarine manufacturing. Fatty acid profiles confirmed the fact that all samples belonged to the hard margarine category. Among tested samples, only one carried a low content of TFA, i.e.,

2.2%, while the rest possessed high amounts of TFA (11.50 to 34.80%) which clearly indicates the incorporation of partially hydrogenated oils in the production of margarines.¹⁵

A study was conducted in 2009 to estimate TFA content in cooking oil and partially hydrogenated oil samples. The generated data revealed that cooking oil had a low TFA content of 0.40–1.80, whereas TFA contents of partially hydrogenated oil samples were high. Among the analyzed samples, the highest level of TFA was observed as 26.50% and the lowest as 9.12%. TFA level was found to be >10% in the rest of the analyzed partially hydrogenated samples.¹⁶

In another research study conducted in 2012, Pakistan's five most popular brands of margarine and vanaspati ghee were analyzed for TFA content. The margarine samples showed variable TFA levels ranging from 1.56 to 23.99%, whereas in all of the vanaspati ghee samples, the value of TFA remained >5% and varied between 5.36 to 33.03%.¹⁷

3.2.2. Prevalence of TFA in Industrially Produced Foods

A number of studies have been carried out in Pakistan to identify the industrially produced TFA precursor foods.

3.2.2.1. Baked and Fried Products

In a study conducted by Kandhro *et al.* (2008), fat from 12 brands of biscuits was analyzed for its fatty acid composition with special focus on TFA level. A high amount of TFA was observed in all biscuit samples and ranged between 9.3 to 34.9%. The presence of an elevated level of TFA

along palmitic acid suggested that the industrial margarines prepared from partial hydrogenation of palm oil were an ingredient of the manufactured biscuits.¹⁸

A study carried out in 2010 on some breakfast cereals showed that these contain varied amount of TFA contents. This study reported that the content of TFA ranged from 14.40 to 16.30% of fat in breakfast cereals except one sample of corn chips where TFA was found at 2.30% of fat.¹⁹

In a study conducted in 2013, the TFA content was evaluated in two main convenience products, i.e., chocolate and pastry. Six different chocolates and five puff pastry samples were purchased from a local supermarket in Jamshoro. The amount of TFA was observed to be high in all chocolate and pastry samples, varying from 4.56-8.49% and 3.92-10.17%, respectively.²⁰

Breakfast and snack foods are also noted as a major contributor of TFA in Pakistani diet. Research performed in 2016 to determine TFA contents in traditional products like poori, cake, paratha, doughnut, and puff pastry collected from Faisalabad showed the highest TFA content in doughnuts (38.69%), followed by poori (18.48%). In paratha and cake, the TFA contents found were 11.01 % and 12.02% respectively. The lowest TFA value was observed in puff pastry (6.19%). Thus, traditional Pakistani diets carry high levels of TFA.²¹

3.2.2.2. Potato Products

Anwar et al. (2006) reported that TFA content in potato chips ranges from 0.40 to 26.00%.²² In another similar study twelve different brands of potato chips were analyzed for TFA content, which was reported between 4.91 and 14.13%. There was significant variation observed in the

fatty acid profile of all analyzed chips samples; however, high contents of palmitic acid and TFA were evident.²³ Karim *et al.* (2014), investigated TFA levels in French fries sold at different fast food outlets of Karachi. Amongst the samples analyzed, the TFA content for four outlets was in the range of 10-24% of total fat. The rest of the samples contained a low percentage of TFA, i.e., <5% of total fat in French fries. Higher levels of TFA in French fries could be due to repeated use of frying oil.²⁴

3.3. TFA LABELING ON FOOD PACKAGING

Fat rich food groups available at Pakistani market shelves are fats/margarines, ready to cook foods, ready to eat foods, pickles in oil, cheese, bakery products, potato crisp, snacks, potato chips, and biscuits. Nutrition facts tables given on food products can be created by laboratory analysis or by calculation of nutrient on recipe basis. The absence of regulatory mechanism to ensure development of authentic nutrition facts tables through calculation on recipe basis as well as poor knowledge about the fat type used, results in calculation errors in TFA values on nutrition facts tables. If the TFA value calculated or analyzed in a product on per serving basis remains <0.5%, it never appears on labels in Pakistani products. Only in imported products or products produced by multinational manufacturer are less than 0.5% TFA values on per serving basis reported. Ready to cook products are in semi-finished form; therefore, the choice of fat for frying at house hold level and number of frying cycles applied makes them either TFA rich or not. In baked products where TFA rich bakery margarine is being used in industry, TFA values are reported as zero. This can be considered as misreporting by the manufacturer. The saturated fat and TFA level in a food product largely depends on the type of fat used in recipe and production process. Therefore, while reporting TFA on nutrition fact tables in such

products, accurate laboratory analysis should be carried out rather than calculation of nutrient on recipe/formulation basis.

3.3.1. Regulatory Landscape of TFA Labeling

TFA content is required to be given on labels under Punjab Food Regulations on the following products: cream analogues, vanaspati ghee, margarine, dried ice cream mix/ dried frozen dessert/ confection, whereas in Khyber Pakhtunkhwa (Food Standards) Regulations (2018) labeling is required for vanaspati ghee, margarine, dried ice cream mix/ dried frozen dessert/ confection. Neither in national standards, nor in remaining provincial regulations, are any other labeling requirements for TFA. However the monotonous labels of export brands resulted in tabulation of TFA content at nutrition fact table given on labels of product being sold within the country.

3.4. MEASURES FOR TFA CONTROL IN FOOD REGULATIONS IN PAKISTAN

The food regulations are not harmonized in the country for control of dietary risk factors of NCDs. National, provincial, and regional food regulations were reviewed and coverage for TFA in those standards was evaluated. .

3.4.1. TFA Limits Set in National Standards Framed by Pakistan Standard and Quality Control Authority (PSQCA)

PSQCA regulates production and import of vanaspati ghee, margarine, butter, and a number of oil products under a list of compulsory items. It is pertinent to mention that the TFA limit (<5%) has been described in only one PSQCA standard, i.e., PS 221 (Pakistan Standard

Specifications for Vanaspati). It has also been proposed to bring TFA level at par to the guidelines of WHO by year 2023 in this mandatory standard.

3.4.2. Regulatory Framework for TFA in Provincial and Regional Regulations

Sindh Food Authority Regulations (2018) are in line with Pakistan Standard requirements set by PSQCA. Fats and oils are covered in Chapter 2 of Sindh Regulations (2018) where TFA control limit for any food article except vanaspati ghee is not mentioned. For vanaspati ghee this limit is set at 5%.²⁵

TFA limits have been set for different fat and oil and other food products in Punjab Pure Food Regulations (2018)²⁶ and The Khyber Pakhtunkhwa (Food Standards) Regulations (2018).²⁷ The description of these products, limits for TFA and other requirements are given in Table 2 and 3 respectively. An old food standard (Pure Food Rules 1965)²⁸ has been implemented in the Balochistan province as well as Gilgit Baltistan and Azad Kashmir regions therefore TFA limit has not been found available for any product in these rules.

4. RECOMMENDATIONS TO REDUCE TFA BASED ON REPLACE ROADMAP

The REPLACE package issued by WHO, is a roadmap to reduce and eliminate industrially-produced TFA from the food supply. Complete set of Pakistan specific recommendations for implementation of REPLACE package for TFA elimination are prepared. These recommendations are in line to the REPLACE package's second and third strategic actions i.e. promote replacement of industrially produced TFA with healthier oils and fats; and legislate or enact regulatory actions to eliminate industrially produced TFA. Being in line to these strategic

actions, this set of recommendations for TFA control can provide a mode of action for other nations from Middle East and South Asia having similar dietary patterns.

4.1. Promotion of research on healthier replacement of traditional vanaspati ghee/bakery fats.

Joint research projects should be carried out on healthy alternatives through public and private organizations, whereas engagement of government for policy review is needed. Cost implications and insufficient information are perceived as big challenges towards reaching research based solutions for TFA elimination. Information sharing through common dashboard to promote research on formulation development for healthy alternatives could be one area of activity.

4.2. Only products containing healthy fats and oils should be procured for public institutions and in government programs.

Increased understanding towards selection of healthy fat choices along availability of such products can help to procure TFA free food products in institutions and programs. Advocacy material should be developed to educate population to make healthy choices. Currently focus is more on food safety and hygiene while making the procurement decisions than consideration for diseases (NCDs). Implementation of healthy food guidelines and advocacy with key stakeholders to revise procurement policy at public organizations, to consider healthy choices can help to implement this proposed action.

4.3. Effective use of Professional Societies, Forums, Associations and Bodies.

Lack of engagement, coordination and sensitization of professional societies, forums, associations and bodies on NCDs and disease prevention is evident at present. The government bodies or key civil society stakeholders can take lead in educating the public. It can be accomplished through identification and sensitization of relevant stakeholders working in NCDs. Development of dedicated national and provincial level technical bodies/committees having multi-sectorial coordination can also assist moreover civil society should be encouraged to play its role.

4.4. Awareness among policy-makers

It is highly required to gain support from policy makers for the development of legislations and regulations and for their enforcement and compliance. At present awareness on regulations is poor among masses as well as it is not on priority of policy makers. Eagerness level of policy makers to receive information is a big challenge. Strong advocacy and lobbying with parliamentarians and policy makers for enforcement of regulations could help. Mass media campaigns and high level involvement of parliamentarians should also be considered to achieve this objective.

4.5. Food standards should be harmonized for control of dietary risk factors.

National and provincial food standard requirements should be reviewed and must be amended and harmonized taking the dietary risk factors and global regulatory best practices for their control into consideration. There are certain challenges ahead including diversity of dietary

practices, lack of national consensus on standards and lack of awareness of health hazards of dietary risk factors. National standards formulating body should have representation of all provinces for this purpose with strict implementation in place.

4.6. Regulatory control for foods carrying TFA should be restricted to reach the shelves of canteens and tuck shops around the educational institutions.

After provincial interventions in Punjab and KP, for ban imposition on snacks and carbonated drinks in schools and colleges, no real challenge exists to achieve this action goal. In this regard strict regulations for food categories should be implemented and healthy alternates made available.

4.7. Food labeling laws

These need to be amended so that clear information may remain in access to the consumer to choose the healthy food. Front of pack nutrition labeling for dietary risk factors, is required. Thus health warnings about level of dietary risk factors should be placed on front of pack. These labeling laws for all categories of food should be enforced with true spirit.

5. CONCLUSION

This study confirms that TFA prevalence is an indigenous problem for Pakistan. Vanaspati ghee is the basic precursor of TFA followed by bakery shortening, hard margarines and fat spreads. In order to eliminate TFA from food chain a comprehensive national strategy for TFA elimination based on knowledge of TFA prevalence associated regulatory control is suggested. We recommend to: (1) promote actions towards replacement of traditional vanaspati ghee/bakery

fats with healthier alternatives; (2) develop and implement best regulatory practices in line with WHO recommendations; (3) amend food labeling laws so that clear information will be provided to inform consumers' healthy food choices.

ACKNOWLEDGEMENT

This study was coordinated by WHO Regional Office for the Eastern Mediterranean, WHO Country Office- Pakistan, Ministry of National Health Services, Regulations and Coordination, Pakistan and Resolve to Save Lives - an initiative of Vital Strategies. We would also like to acknowledge the support of the mentorship collaboration consisting of U.S. Centers for Disease Control and Prevention, Resolve to Save Lives, World Hypertension League, and Lancet Commission on Hypertension Group.

REFERENCES

1. WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland 2013; p. 3.
2. WHO. World Health Organization - Noncommunicable Diseases (NCD) Country Profiles. 2018: p.157.
3. Roy NC, Kane TT, Barkat-e-Khuda. Socioeconomic and health implications of adult deaths in families of rural Bangladesh. *Health Popul Nutr* 2001;19(4):291-300.

4. Jafar TH, Haaland BA, Rahman A, Razzak JA, Bilger M, Naghavi M. Non-communicable diseases and injuries in Pakistan: strategic priorities. *Lancet* 2013;381:2281-90.
5. PHRC. Non-Communicable Diseases Risk Factors Survey Pakistan. Pakistan Health Research Council, Islamabad. 2013; p. XIII.
6. Wang Q, Afshin A, Yakoob MY, Singh GM, Rehm CD, Khatibzadeh S, et al. Impact of non-optimal intakes of saturated, polyunsaturated, and *trans* fat on global burdens of coronary heart disease. *JAMA* 2016;5:e002891.
7. Micha R, Khatibzadeh S, Shi P. Global, regional, and national consumption levels of dietary fats and oils in 1990 and 2010: A systematic analysis including 266 country-specific nutrition surveys. *BMJ* 2014;348.
8. Rashida Haq. Estimating demand and supply of edible oil in Pakistan. *Pakistan J. Agric. Soc. Sci.* 1993; 6 & 7,(1 & 2):13-24.
9. Al Jawaldeh A, Al-Jawaldeh H. Fat intake reduction strategies among children and adults to eliminate obesity and non-communicable diseases in the Eastern Mediterranean Region. *Children* 2018;5:89. doi:10.3390/children5070089.10.
Ghebreyesus TA, Frieden TR. REPLACE: a roadmap to make the world *trans* fat free by 2023. *The Lancet* 2018. [https://doi.org/10.1016/S0140-6736\(18\)31083-3](https://doi.org/10.1016/S0140-6736(18)31083-3).
11. FBR. 2019. Provisional Trade Statistics - Import / Export by Commodity. <http://www.fbr.gov.pk/TradeStatistics/PCTSUMMARY411.ASPX>. Accessed February 23, 2019.

12. Iqbal T, Deshmukh I. Edible oil industry sector update. JCR-VIS Credit Rating Company Limited. 2018; Retrieved from <http://jcrvis.com.pk/docs/EdibleOil201806.pdf>, Retrieved on 8/2/2019.
13. Bhangar MI, Anwar F. Fatty acid (FA) composition and contents of *trans* unsaturated FA in hydrogenated vegetable oils and blended fats from Pakistan. J Amer Oil Chem Soc 2004;81(2):129-134.
14. Anwar, F, Bhangar MI, Iqbal S, Sultana B. Fatty acid composition of different margarines and butters from Pakistan with special emphasis on *trans* unsaturated content Journal of Food Quality. 2006;29(1):87–96.
15. Kandhro A, Sherazi STH, Mahesar SA, Bhangar MI, Talpur MY Rauf A. GC-MS quantification of fatty acid profile including *trans* FA in the locally manufactured margarines of Pakistan. J Amer Oil Chem Soc 2008;109(1):207-211.
16. Sherazi STH, Kandhro A, Mahesar SA, Bhangar MI, Talpur MY, Arain S. Application of *transmission* FT-IR spectroscopy for the *trans* fat determination in the industrially processed edible oils. Food Chem 2009;114(1):323-327.
17. Naz R, Anjum FM, Rasool G, Nisar MA, Batool R Saeed F. Total *trans* fat content in commercially available hydrogenated vegetable oils. Pak J Nut 2012;11(2):145-149.
18. Kandhro A, Sherazi STH, Mahesar SA, Bhangar MI, Talpur MY, Arain S. Monitoring of fat content, free fatty acid and fatty acid profile including *trans* fat in Pakistani biscuits. J Amer Oil Chem Soc 2008;85:1057–1061.

19. Mahesar SA, Kandhro AA, Cerretani L, Bendini L, Sherazi STH, Bhanger MI. Determination of total *trans* fat content in Pakistani cereal-based foods by SB-HATR FT-IR spectroscopy coupled with partial least square regression. Food Chem 2010;123:1289–1293.
20. Aftab, A K, Sherazi, STH, Rubina, S, Razia, S, Ambrat and Arfa, Y. Consequence of fatty acids profile including *trans* fat in chocolate and pastry samples. Int Food Res J 2013;20(2):601-605.
21. Shah F, Rasool G, Sharif MK, Pasha I, Ahmad S, Sharif, HR. Determination of *trans* fat in traditional Pakistani breakfast and snack foods. Int Food Res J 2016;23(2):849-853
22. Anwar F, Bhanger MI, Latif S, Manzoor M. Lipid content and fatty acid composition of some deep fried and fast foods from Sindh, Pakistan. J Amer Oil Chem Soc 2006;28(4):374–379.
23. Kandhro A A, Sherazi STH, Mahesar SA, Talpur MY, Latif Y. Variation in Fatty Acids Composition Including *Trans* Fat in Different Brands of Potato Chips by GC-MS. Pak J Anal Environ Chem 2010;11(1):36-41.
24. Karim, Z, Khan K, Ahmed S and Karim A. Assessment of *trans* fatty acid level in French fries from various fast food outlets in Karachi, Pakistan. J Amer Oil Chem Soc 2014;91(11):1831-1836.
25. Government of Sindh. 2018. Sindh Food Authority Regulations, 2018. <http://sfa.gos.pk/wp-content/uploads/2018/12/Sindh-Food-Authority-Regulations.pdf> accessed on February 27, 2019.

26. Government of Punjab. 2018. Pure Food Regulations 2018 (Punjab).
27. Government of KPK. 2018. The Khyber Pakhtunkhwa (Food Standards) Regulations, 2018.
28. Government of Balochistan. 1965. Pure Food Rules 1965 (Balochistan).

FUNDING

This study was funded by WHO Regional Office for the Eastern Mediterranean, WHO Country Office- Pakistan, Ministry of National Health Services, Regulations and Coordination, Pakistan and Resolve to Save Lives - an initiative of Vital Strategies. Resolve to Save Lives is funded by Bloomberg Philanthropies, the Bill & Melinda Gates Foundation, and Gates Philanthropy Partners, which is funded with support from the Chan Zuckerberg Foundation.

DISCLOSURE: None

Table 1. Trans Fat Content in Fats and Oils in Pakistan

S. No.	Fat and Oil Products	TFA CONTENT (% of product)	Ref.
1	Margarine (Brand M-C)	34.80	13
2	Vegetable ghee (Brand V3)	33.03	15
3	Margarine (Brand M-D)	32.60	13
4	Shortening (Industrial 1)	31.70	11
5	Margarine (Brand M-J)	30.30	13
6	Vegetable ghee (Brand V4)	28.85	15
7	Shortening (Puff)	28.59	11
8	Shortening (Champion industrial)	28.00	11
9	Shortening (Tullo)	27.40	11
10	Shortening (Industrial 2)	26.65	11
11	Vanaspati Ghee (Sample PHO-2)	26.51	14
12	Margarine (Brand M-E)	26.50	13
13	Margarine (Brand M-A)	26.40	13
14	Margarine (Brand M3)	23.99	15
15	Shortening (Backman Puff)	23.37	11
16	Margarine (Bakery 3)	23.09	11
17	Margarine (Brand M4)	22.16	15
18	Vegetable ghee (Brand V5)	22.11	15
19	Bakery Margarine 3	21.10	12
20	Vanaspati Ghee (Sample PHO-7)	20.21	14
21	Margarine (Brand M1)	19.04	15
22	Vegetable ghee (Brand V1)	18.57	15
23	Shortening (Industrial 3)	18.29	11
24	Vanaspati Ghee (Sample PHO-5)	16.32	14
25	Margarine (Bakery 1)	16.10	11
26	Margarine (Brand M-I)	15.60	13
27	Bakery Margarine 5	15.47	12
28	Vanaspati Ghee (Sample PHO-6)	12.55	14
29	Bakery Margarine 1	12.15	12
30	Margarine (Brand M-H)	11.70	13
31	Margarine (Brand M-F)	11.50	13
32	Shortening (Royal Brown)	11.00	11

33	Vanaspati Ghee (Sample PHO-3)	10.72	14
34	Vanaspati Ghee (Sample PHO-4)	10.69	14
35	Shortening (Backman Bisco)	10.08	11
36	Margarine (Bakery 2)	9.75	11
37	Bakery Margarine 2	9.20	12
38	Vanaspati Ghee (Sample PHO-1)	9.12	14
39	Shortening (Backman Cremo)	8.98	11
40	Margarine (Brand M-G)	8.30	13
41	Bakery Margarine 4	7.95	12
42	Shortening (Royal Blue)	7.34	11
43	Margarine (Pastry)	7.20	11
44	Margarine (Brand M5)	6.73	15
45	Vegetable ghee (Brand V2)	5.36	15
46	Table Margarine 5	5.00	12
47	Dairy Queens Butter	5.00	12
48	Pak Band Butter	4.70	12
49	Table Margarine 4	4.58	12
50	Layl Pur Butter	4.15	12
51	Margarine (Table)	4.08	11
52	Dens Butter	3.80	12
53	Nestle Butter	3.74	12
54	Pak Pure Butter	3.67	12
55	Ali Pur Butter	3.64	12
56	Haleeb Butter	3.52	12
57	Margarine (Creamy)	3.10	11
58	Table Margarine 2	3.00	12
59	Milk Pak Butter	3.00	12
60	Margarine (Sofy)	3.00	11
61	Noor Pur Butter	2.98	12
62	Margarine (Sofy 1)	2.90	11
63	Table Margarine 3	2.50	12
64	Table Margarine 1	2.45	12
65	Margarine (Brand M-B)	2.20	13
66	Margarine (Pak Band)	2.09	11
67	Margarine (Bakery 4)	1.67	11
68	Cooking Oil (Sample CO-12)	1.63	14
69	Margarine (Brand M2)	1.56	15
70	Margarine (Blue Band)	1.45	11
71	Cooking Oil (Sample CO-11)	1.33	14

72	Cooking Oil (Sample CO-13)	1.17	14
73	Cooking Oil (Sample CO-14)	1.14	14
74	Cooking Oil (Sample CO-8)	0.52	14
75	Cooking Oil (Sample CO-10)	0.52	14
76	Cooking Oil (Sample CO-9)	0.45	14

Table 2: Trans Fat limits and other requirements elaborated in Punjab Pure Food Regulations, 2018

Food Article	TFA limits and other requirements
01.4 Cream Analogue	<ul style="list-style-type: none"> • For all cream analogues, shall mention <i>trans</i> fat contents on the label. • Partially hydrogenated vegetable oil shall not be used in the production of these analogue products.
Shortening	<i>Trans</i> fat: Not more than 0.5%
02.3 Banaspati, Vanaspati (Applicable only up till July, 2020)	It shall not have more than 0.5% <i>trans</i> -fat and <i>trans</i> -fat percentage shall be mentioned on the label. After July 2020, there shall be complete ban on any form of Vanaspati.
02.4.1.1 Table Margarine	<i>Trans</i> fat: Not more than 0.5%
02.4.1.2 Industrial Margarine	<i>Trans</i> fat: Not more than 0.5%
02.4.1.3 Margarine Spread	<i>Trans</i> fat: Not more than 0.5%
02.4.1.4 Spread	<i>Trans</i> fat: Not more than 0.5%
02.6 Oils/Fats During Frying	<i>Trans</i> fatty acids: Not more than 5%
13.1 Infant Formulae	The content of <i>trans</i> -fatty acids shall not exceed 3 percent of total fatty acids provided 100 percent milk fat is used in the formula. Plant

	<p>oils and fats intended to be used in infant formula should be virtually <i>trans</i> fat free and the maximum allowance level for <i>trans</i> fatty acids shall be proportionately decreased with increasing level of plant oils and fats in the formula.</p>
<p>13.2 Follow-up Formula</p>	<p>(3) The content of <i>trans</i>-fatty acids shall not exceed 3% of total fatty acids provided 100% milk fat is used in the formula.</p> <p>(4) Plant oils and fats intended to be used in follow-up formula should be virtually <i>trans</i> fat free and the maximum allowance level for <i>trans</i> fatty acids shall be proportionately decreased with increasing level of plant oils and fats in the formula.</p> <p>(5) Plant oils and fats intended to be used in follow-up formula should be virtually <i>trans</i> fat free and the maximum allowance level for <i>trans</i> fatty acids shall be proportionately decreased with increasing level of plant oils and fats in the formula.</p>

Table 3: Trans Fat limits and other requirements elaborated in Khyber Pakhtunkhwa (Food Standards) Regulations, 2018

Food Article	TFA limits and other requirements
Shortening	<i>Trans</i> fat: Not more than 5%
02.3 Banaspati, Vanaspati	<ul style="list-style-type: none"> • It shall not have more than 5% <i>trans</i>-fat and industry will be given a grace period of three years from the implementation of these Regulations to conform to these standards. During this grace period, <i>trans</i>-fats shall be not more than 15%. (mentioned in product description) • <i>Trans</i>-fat percentage shall be mentioned. • <i>Trans</i> Fatty acid content: Not more than 10% (mentioned in product characteristics table)
02.4.2 Table Margarine	<i>Trans</i> fat: Not more than 5%
2.6 Oils/Fats During Frying	<i>Trans</i> fatty acids: Not more than 24 %
13.1 Infant Formulae	Same as given in Punjab Pure Food Regulations, 2018 for similar product
13.2 Follow-up Formula	Same as given in Punjab Pure Food Regulations, 2018 for similar product

