Assessment of trans-fats in the Maldivian diet

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ABSTRACT *Consumption of trans-fatty acids (TFA), which are unsaturated fatty acids, are associated with increased risk of non-communicable diseases. The aim of this study was to assess the trans-fat content in foods consumed by the Maldivian population and their frequency of consumption of fatty foods likely to contain TFA. The methodology consists of a cross-sectional survey of 600 participants. A screening questionnaire was used to measure/assess the frequency of consumptions of foods containing trans-fats. The results showed that the frequency of consumption of foods containing trans-fats/trans-fatty acids were low among the study participants. Some participants reported that they consume locally-made foods or imported foods which contain trans-fats. Since the Maldives do not have legislations to ban trans-fats from food supplies, the country may be vulnerable to importing foods containing high trans-fats. Therefore, the Maldives may need to consider developing policies on TFA content in oils and foods.*

Keywords: Trans-fats, Maldives, frequency of consumption, TFA level, Maldivian diet

Trans-fatty Acids (TFA) are chemically defined as unsaturated fatty acids having at least one or more non-conjugated double bonds in the trans (rather than the typical cis) configuration. In the trans configuration the hydrogen atoms are on the opposite sides of the double bond resulting in a fatty acid that is straight; that is similar to saturated fatty acid structures. Straight chains are more compacted than bent chains and result in less fluid material. They naturally occur through anaerobic fermentation in the gut of ruminant animals and have no known health benefits. Ruminant fat-based foods generally contain natural TFA levels ranging from 2-7%. Industrially produced TFA are formed by modification of unsaturated oils during industrial processing methods, mainly through partial hydrogenation in the presence of a metal catalyst and high heat. The proportion of industrially produced trans-fats in diets are usually much greater than ruminant TFA (WHO, 2018a).

Consumption of TFA is associated with an increased risk of cardiovascular disease (CVD) (WHO, 2018a) and a potential increase in endothelial dysfunction and inflammation (Nishida &Uauy, 2009; Mozaffarian et al., 2009). TFA review of policies to reduce trans-fats which usually consist of setting thresholds limiting allowable TFA in food ingredients or completed food products, or labelling of TFA in pre-packaged processed foods or restaurant and bakery products, implemented singly or in combination have been effective in reducing TFA usage and even translated into reduced CVD in some instances (Downs et al., 2013). Therefore it is important to investigate the trans-fat in the foods which are available and

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consumed in the Maldives, it is also important to review national policies/ regulations in relation to oils and fats to see the current status of regulations with regard to TFA.

Such oils are present in bakery products (e.g. pies, biscuits and crackers), fried foods, pre-mixed products (e.g. hot chocolate mix, pancake) and pre-packaged snacks, prepared snacks and food including fried and baked street and restaurant foods, besides spreads and cooking oils. Also, industrially-produced TFA is present as ingredients in margarine, vanaspati ghee, doughnuts, baked goods such as crackers, pies and biscuits. These partially hydrogenated oils lower oxidation potential, modify the texture of food and are cheap compared to animal fats. Thus, TFA is used to replace butter, and enhance shelf life of food products. The popularity of TFA surfaced between the 1950s and 1970s (Lichtenstein, 2014). There is some evidence that very elevated temperatures produce TFA in moderate levels, 3.67 g/100g for heating, and 3.57 g/100g for frying. However, no evidence is available in the production of TFA due to baking, grilling, and boiling (Bhardwaj et al., 2016; Moreno et al., 1999; Dobarganes &Márquez-Ruiz, 2015: Przybylski &Aladedunye, 2012). The level of trans-fat in partially hydrogenated oils (PHO) is between 25-45% while the heating or frying polyunsaturated oils generate only 3% of TFA (Bhardwaj et al., 2016).

The World Health Organisation (WHO) recommends eliminating TFA as it will cost the government the lives of its citizens, and thus it could be a cost-effective intervention. The WHO published a6 step action plan, abbreviated as REPLACE, that guides countries to eliminate TFA from their food products. Partially hydrogenated oils (PHO) could be replaced with beneficial oils such as oils rich in polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA).

The WHO recommends that the daily consumption of TFA should be less than 2.2g/day in a 2,000- calorie diet, that is less than 1% of total energy intake (WHO, 2018b). Reducing TFA reduces CHD and mortality thus reducing noncommunicable disease and premature deaths, which is one of the United Nations Sustainable Development Goals (Goal 3.4) (United Nations General Assembly, 2016).

Current knowledge about the dietary intake of TFA is not well known in low and middle-income countries (WHO, 2018c). This important information is required in order to eliminate TFA worldwide. Currently available data highlight that TFA intake varied from 0.3% of total energy intake in China to TFA of 4.2% of total energy intake in Iran. According to the Global Burden of Disease, TFA as a proportion of total energy intake per person ranged between 0.2% to 6.5% (Micha et al., 2014).

Some countries have monitored the TFA content in food and have legislated a limit of TFA content in food products. For example, in 2003, Denmark implemented legislation that TFA should not exceed more than 2% of total fat content of the food as food available in the marketplace and restaurants, including imported food (Downs et al., 2013). Denmark observed an effective reduction in TFA in their food supply through the regulation (Leth et al., 2006). As a result, other European countries including Hungary, Austria Norway and Iceland, and some countries in Asia, America, and Africa have legislated limits on TFA in the food supply. Some countries such as the United States of America and Canada also banned the source of industrially-produced trans-fat, that is partially hydrogenated

oils (Leth et al., 2006' WHO, 2018a). Some countries coordinate and voluntarily have been working on reducing TFA in food products. For example, the Canadian Trans-Fat Task Force recommended that soft spreadable margarines and vegetable oils not exceed more than 2% TFA of total fat content (Angell et al., 2009). Also, in Lithuania the use of industrially-produced TFA in school food is banned (Ministry of Health of the Republic of Lithuania, 2011).

Labelling food containing TFA would also aid in reducing TFA intake. For instance, in 2005,Canada implemented a requirement of food labels to contain TFA content; and later similar actions were implemented in other countries such as America. Increased awareness through food labelling would aid in reducing TFA consumption. However, private food outlets such as street vendors do not label the food and thus may not be applicable for the labelling restriction based TFA reduction (WHO, 2018a).

For trans-fat analysis, food sources that contain TFA should be sampled and analysed for trans-fat, saturated fatty acids (SFA), monounsaturated fatty-acids (MUFA), and polyunsaturated fatty acids (PUFA). By analysing SFA, MUFA, and PUFA the results would help in understanding what replaces trans-fat. These analyses should be recorded in a database. The database should also record the nutrition label of the food that include these SA, MUFA, and PUFA besides the trans-fat information (WHO, 2018c).

While elimination of industrially produced-TFA is a goal globally, there is a lack of data in the Maldives regarding TFA in the food products. The awareness on the matter, by consumers and other relevant agencies in the Maldives, is low. Thus, it is crucial to assess the landscape around TFA in the Maldives to increase awareness on the negative impact of consumption of TFA, and there is also a need to develop regulations where necessary to ban TFA in the country.

To determine source of TFA in the diet of the Maldivian population, there is a need to assess their dietary intake and to measure trans-fat in the food they consume.

Methods

A screening questionnaire was developed taking into account the foods containing fats that are commonly consumed by Maldivians, and are likely to contain trans-fats. The research team prepared the data coding of the questionnaires validated through pilot testing. The questionnaire was administered online through the survey software tool, IZI Survey. Upon completion of the questionnaire design, the research team administered the questionnaire among the selected 10 people for pilot testing. The data collected during pilot testing was analysed at item level to refine the final questionnaire. The pilot testing was carried out in Male' and Huraa. The questionnaires were administrated by enumerators especially trained for this project.

The fat screening questionnaire was administered to participants from three clusters from the Maldivian population; namely Fuvahmullah, Haa Dhaalu (Kulhudhuffushi) and greater Male'. The sample size was calculated to provide adequate description of trans-fat dietary intake of the population. The following prevalence formula for cross sectional studies was employed for this study.

$$n = \frac{Z^2P(1-P)}{d^2}$$

Where n = sample size, Z = Z statistic for a level of confidence, P = expected prevalence or proportion by using the data from other countries (in proportion of one; if 15%, P = 0.15), and d = precision (in proportion of one; if 5%, d = 0.05). Z statistic (Z): For the level of confidence of 95%, which is conventional, Z value is 1.96. For this study, the investigators present their results with 95% confidence intervals (CI). The sample size for each island was 200 assuming that the prevalence of trans-fat intake is 15%. Hence, the total required sample size was 600 participants from three regions. The number of households from each of the selected islands were identified using systematic sampling and the individual from the household was selected randomly.

Data entry and analysis

The data from the completed questionnaires was captured through an automated process from the IZI survey tool. The data was then checked for inconsistencies and outliers to ensure that invalid data was eliminated. The data was then analysed to provide an indication of the degree to which the population groups consumed foods containing trans-fats. SPSS software was used to analyse the data.

Results and interpretation

The total number of people who participated in the survey was 668. A sample of 200 or more was taken from three areas namely Male' region, Gn. Fuvahmulaku and HDh. Kulhudhuffushi. Majority of the participants were females. Most of the respondents were from the age group 21-30 years. The educational level of most of the participants were secondary school or lower. Close to 30% had completed high school or equivalent qualification, 10% have bachelor's degrees and 4% have masters' degrees. While 38% of the participants are in full-time jobs and 6.3% are in part-time jobs. It is an important point to note that 13.9% of the participants are from the age group (10-15 years old) and only 0.2% said that they were studying. It is possible that they had finished secondary school and are waiting for opportunities for studies or work. More than 75% of the participants get less than MVR 10,000 per month as personal income. As shown in table 1, 21.7% of the participants get between MVR 10,000 and 20,000. More than half (56.2%) of the participants said that they spend less than 30% of the salary on food (Table 1).

Table 1
Demographic information of the participants

Demographic characteristics	Percentage
Gender	
Male	30.3

Female		69.7
Age		
15-10	13.9	
20-16	14.4	
30-21	56.4	
40-31	10.5	
40 and above	4.8	
Educational level		
Secondary school and lower	55.2	
High school and equivalent	29.2	
Bachelor's degree	11.1	
Master's degree	4.4	
Employment		
Full-time	38.2	
Part-time	6.3	
Unemployed	30.8	
Retired	24.6	
Studying	0.2	
Salary		
Less than MVR 10,000	75.7	
MVR 20,000-10,000	21.7	
MVR 30,000-20,000	2.5	
More than 30,000	0.2	
Percentage of income spent on food		
Less than %30	56.2	
%50-31	35.2	
%70-51	5.7	
More than %70	2.9	

Table 2 shows the frequency of intake of fatty foods that are likely to contain TFA. The foods that are eaten most often by Maldivians which are likely to include trans-fats are, roshi, bread, curry, kulhimas (sautéed tuna), luncheon meat, and fried chicken. Roshi and curry is a popular dish Maldivians consume that has a large amount of fats and oils. An interesting observation from the data was that close to 50% of the Maldivians who participated in the survey reported that they

do not eat Maldivian short-eats. Although it was assumed that the data may be skewed due to location and percentage of the working population who participated in the survey, disaggregated data by location and employment did not show any differences. Most of the participants said that they do not reuse oil for food preparation. Almost half the population reported that they do not use ghee for cooking and those participants who use ghee, use it less than once a week or rarely. A similar percentage of participants said that they do not eat food from street vendors and cafes.

Table 2
Frequency of food intake related to trans-fat

	Percentage of population (%)				
Practice	More than 6 times weekly	5-3 times weekly	2-1 times weekly	Less than once weekly or rarely	Do not eat
Frequency of consumption of fried food with batter or breadcrumb coating (example: kavaabu bajiyaa, gulha, fried wontons or cutlets)	5.5	4.4	13.9	27.8	48.3
Frequency of consumption of food with cream sauces, submarine cream or cheese sauces	6.1	8.7	22.3	35.8	27.1
Frequency of consumption of butter, margarine, oil or ghee to vegetables, cooked rice or parathas	1.8	3.1	5.0	13.8	76.3
Frequency of consumption of vegetables that are fried or roasted with fat or oil	3.1	5.2	12.4	20.3	59.0
Frequency of consumption of fried chicken products or fried fish products (example: fried chicken, chicken nuggets, fish fingers, etc.)	17.1	13.3	26.8	26.3	16.5
Frequency of consumption of white bread, brown bread, buns or roshi	67.9	9.9	12.7	5.5	4.0

Frequency of consumption of luncheon meats (example: cold cuts, canned lunch meats of chicken or beef)	22.2	17.4	27.2	22.0	11.2
Frequency of consumption of potato wedges, yam fries, breadfruit chips or French fries	2.9	6.9	13.0	38.5	38.7
Frequency of consumption of muffins, cakes, wafers, donuts or sweet biscuits that are prepackaged or purchased from stores or bakeries	7.6	11.8	15.3	31.0	34.3
Frequency of consumption of chocolate, chocolate biscuits or snack bars	17.6	20.0	21.7	25.1	15.6
Frequency of consumption of prepackaged potato crisps, cassava crisps or nuts	6.7	9.6	17.9	27.2	38.5
Frequency of consumption of githeyo boakibaa, dhonkeyo kajuru, foni kaamanga or gulab jamun	.9	2.6	6.7	18.8	70.9
Frequency of consumption of pizza	.9	3.5	14.7	55.2	25.7
Frequency of consumption of roshi and curry or roshi and kulhimas	29.7	23.7	19.1	13.5	14.1
Frequency of consumption of bajiyaa, fuh-jehi kavaabu or petties	1.7	3.7	12.2	33.2	49.2
Frequency of consumption of savoury pastries such as sausage rolls, curry puffs or bis keemiya	4.9	12.1	20.5	33.6	28.9

Frequency of consumption of vegetable shortening, ghee or margarine in your cooking	2.3	5.4	13.3	31.7	47.4
Frequency of consumption of the oil previously used for food preparation (example: deep frying)	2.8	2.8	7.3	21.1	66.1
Frequency of consumption of food from street vendors, small cafes, fast food joints, bakeries or restaurants	.9	4.4	23.7	23.5	47.4
Frequency of consumption of three-in-one coffees (*-3in1- coffee is coffee consisting of coffee, sugar and creamer)	2.8	5.0	17.4	41.9	32.9

As shown in figure 1, 48.9% of the participants said that they do not spread margarine or butter on bread. Over 90 % of the population use coconut milk for cooking. It is ingrained in Maldivian culture to use coconut milk for cooking instead of dairy milk or soya milk (Figure 2)

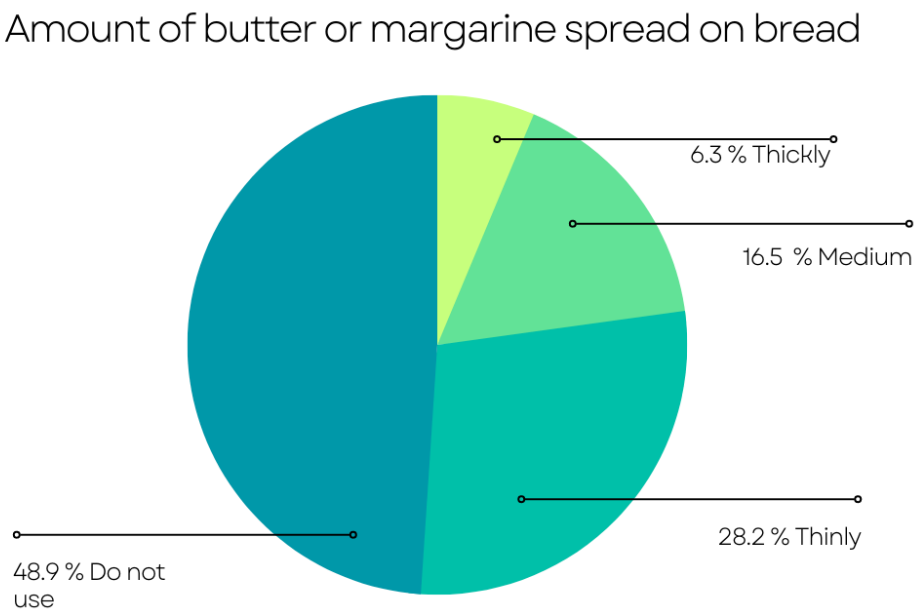

Figure 1. Amount of margarine or butter spread on bread

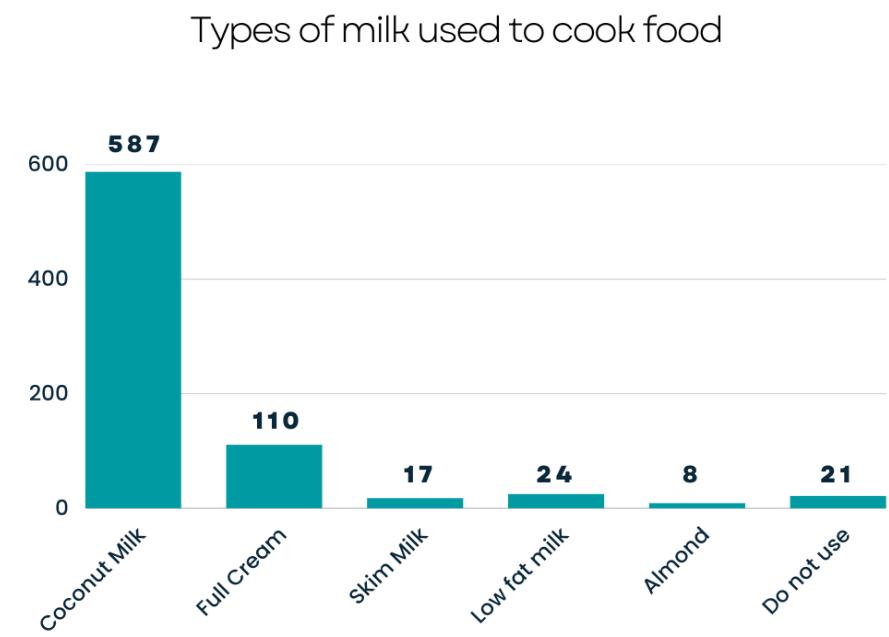

Figure 2. Type of milk used for cooking

As shown on Figure 3, full cream milk was used by most of the respondents (55%) (467 people) with tea or coffee. Condensed milk was used by 163 (19%) people and 93 people (11%) did not use any milk. A total of 100 people use either skim milk or low-fat milk.

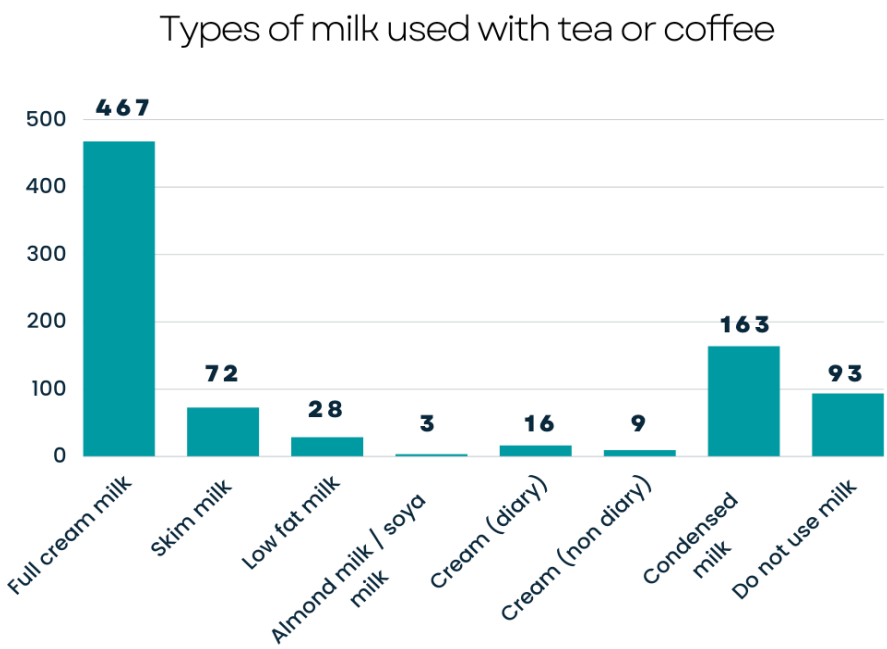

Figure 3. Type of milk used with tea or coffee

Figure 4. Frequency of consumption of food from street vendors, small cafes, fast food outlets and bakeries disaggregated by employment status

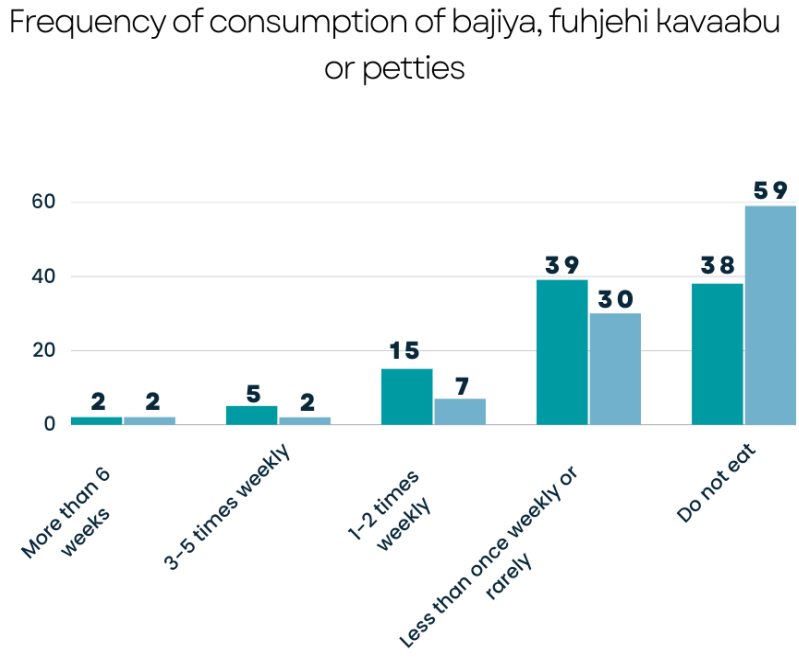

Figure 5. Frequency of consumption of bajiya, fuhjehi kavaabu or petties

Figure 4 and 5 show disaggregated data for the employed and unemployed

participants' eating at street vendors, bakeries and restaurants' and eating short eats. The disaggregated data did not show any significant differences between working and non-working groups. There are slight differences in the consumption of fried short eats among people who are employed and unemployed. More employed people eat fried short eats compared with unemployed people. However, this difference is not statistically significant.

Discussion

The foods that are eaten most often by Maldivians which are likely to include trans-fats are, roshi, bread, curry, kulhimas (sautéed tuna), luncheon meat and fried chicken. Roshi and curry is a popular dish that Maldivians consume that can contain large amounts of fats and oils. According to Naila et al. (2022) the aforementioned Maldivian foods do not contain trans-fats in them. Some fats and oils that were consumed in Maldives had TFA in the label aligned to the laboratory analysed trans-fat content (Consul Olive oil, and Shifa pure vegetable cooking oil) to some extent while others had some variations (Daisy margarine and GRB ghee). The difference in Daisy margarine was that the label says 0.4% TFA while the laboratory analysis did not detect TFA. The label of Kraft Cheddar cheese spread stated that it contained 1.678g/100g trans-fat while laboratory testing revealed it had 0.015% trans-fat. These variations could be due to the difference in the use of laboratory equipment and testing variations at different laboratories, variations due to analysis by different people and difference in methods (Naila et al., 2022). Hence, the amount of trans-fat in the Maldivian diet is low.

An interesting observation from the data was that many participants reported that they do not eat Maldivian short-eats which are famous for evening tea in the Maldives. One reason might be that the short eats discussed in the survey were only fried ones and many Maldivian's favourite short eats are baked. There is limited evidence available in the production of TFA caused by baking, grilling and boiling (Bhardwaj et al., 2016; Moreno et al., 1999; Dobarganes and Márquez-Ruiz, 2015; Przybylski and Aladedunye, 2012). According to Naila et al. (2022), "kudhi gulha" made by frying and haalu folhi made by heating, contained trans-fats. These are consumed less frequently by Maldivians and the most frequently consumed foods in the current study are below the range of aforementioned TFA values and are far below compared to other countries.

This study showed that most of the participants do not reuse oil for food preparation which is a positive practice. Studies show that heating edible oils to common cooking temperatures (≤ 200 °C) has minimal effect on TFA generation whereas heating to higher temperatures can increase TFA level (Bhat et al., 2022).

This provides further evidence in favour of public health advice that heating oils to very high temperatures and prolonged heating of oils should be avoided (Bhat et al., 2022). Almost half the participants reported that they do not use ghee for cooking and those participants who use ghee use it less than once a week or rarely. In countries like Pakistan ghee is used frequently in their diet and Vanaspati ghee is identified as one of the major sources of TFAs (Tarar et al., 2020).

Half of the participants of this study said that they do not eat food from street vendors and cafes which means almost half of the Maldivian community eat home made meals. Analyses of foods sold by street vendors in Kyrgyzstan and Tajikistan

reported that the TFA content of pre-packaged wafers was more than 100% of the recommended daily limit for TFA intake (3.8 and 2.5g TFA per serving, respectively); some freshly prepared foods had levels almost as high (World Health Organisation, 2018). A survey of street food in India (Delhi and Haryana) found that 25% of snack foods had levels of TFA exceeding the legal limit set by Denmark (Gupta et al., 2016). In six Eastern European countries, hundreds of products containing high levels of TFA were found in grocery stores in 2014, almost double the number found in 2012 (Gupta et al., 2016). Moreover, grocery stores of Eastern European countries contained food products that exceeded amounts of TFA (Stender et al., 2016).

Denmark observed TFA reduction in their food supply in this manner very effectively (Leth et al., 2006). The food products tested in the Maldives had less than 2% TFA as previously discussed. Some countries such as the United States and Canada also banned the source of industrially-produced trans-fat, that is partially hydrogenated oils (Leth et al., 2006; WHO, 2018a). Some countries coordinate and voluntarily have been working to reduce TFA in food products.

Labelling food with TFA would also aid in reducing TFA consumption. For instance, Canada implemented a requirement of food labels to contain TFA content in 2005 and later similar regulations were implemented in other countries such as America. Increasing awareness among consumers would aid in reducing TFA as once they see the food containing TFA they would avoid the food, if the negative impact of TFA consumption is well understood by the consumers. However, in informal food sectors such as street vendors, the foods are not labelled and thus may not be applicable the labeling restriction based TFA reduction (WHO, 2018a). As almost all the food products are imported in the Maldives, a regulation could be made which mandates the food imported to be labelled with TFA values.

However, what is of concern is that as more and more countries develop legislation and ban trans-fat from food supplies, countries without legislation may be vulnerable to the import of foods containing high trans-fats. Therefore, labelling alone will be inadequate, and the country may need to consider a ban on TFA containing oils and foods.

Conclusions and recommendations

The dietary intake data showed that the foods which had trans-fats were consumed infrequently by most of the population. Despite the low levels of TFA in food products in Maldives, as more and more countries develop legislation and ban trans-fat from food supplies, countries without legislation may be vulnerable to the import of foods containing high trans-fats. Therefore, the Maldives may need to consider further policies on TFA content in oils and foods. This could take the form of mandatory TFA levels less than 2% of total fat in oils, fats and foods together with a complete ban on partially hydrogenated oils and fats, as well as a requirement for the labelling of TFA in processed packaged foods- most of which are imported to the country. There is also a need to conduct the survey with a bigger sample size over a wider area across the Maldives.

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