Trans Fatty Acids in Tanzania: are Consumers and Processors Aware of the Associated Health Hazards? a Case of Morogoro

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Abstract

Several studies have shown an association between Trans Fatty acids (TFAs) consumption and increased risk of cardiovascular diseases (CVD). FAO and WHO recommend that the TFAs in human dietary fat should be reduced to less than 1%. This study was conducted to assess the awareness regarding TFAs among consumers and food/oil processors in Morogoro region, using a cross-sectional study design. Study sample included 340 households, whereby 176 were from Morogoro urban and 164 from Morogoro rural districts, as well as 32 food/oil processors (22 = small scale; 10 = large scale). Structured questionnaires were used to collect data. Descriptive statistics were conducted to determine the awareness on TFAs and the health effects associated with the consumption of foods containing TFAs. About 98% of all consumers had neither knowledge nor awareness about TFAs and associated health effects. Nevertheless, awareness level was observed to improve with residence location and level of education. The level of awareness of TFAs in MjiMkuu ward (urban) was significantly different from Kiroka ward in rural area (OR:=18.111; P= 0.020). No significant differences were observed in the level of awareness between consumers in Kiroka (rural) and in Mazimbu ward (urban) (OR:= 5.397; p=0.126). Large scale food and oil processors were more aware about TFAs than small scale food and oil processors. General awareness on TFAs and the associated adverse health effects among consumers were very low compared to that of processors which were also influenced by residential location and level of education. The current study shows that consumers in the study area were at high risk of exposure to TFAs and developing conditions such as cardiovascular diseases (CVDs) which may result in stroke, leading to significant disability, emotional problems and death in the worst case.

Keywords: TFAs, Cardiovascular Diseases, Awareness, Consumers, Food/Oil Processors

Introduction

Trans fatty acids (TFAs) are types of unsaturated fatty acids and can be classified as either naturally occurring or industrially produced (Kamel, *et al.,* 2018). Naturally occurring TFAs or ruminant Trans fatty acids (rTFAs) are found in small amounts (3-6%) in food products such as meat and milk products from animals (Mouratidou *et al.,* 2014). Industrially produced Trans fatty acids (iTFAs) are formed by the process of partial hydrogenation in the industrial production of partially hydrogenated oils (PHOs) (Tsuzuki *et al.,* 2010; Afaneh *et al.,* 2017; Pfeuffer and Jahreis, 2018). During the process, oil is hardened, which improves its commercial appeal by enhancing its sensory and texture profiles, also increasing its shelf life; factors that often attract most food manufacturers to prefer PHOs (Dhaka *et al.,* 2011; Mouratidou *et al.,* 2014; Blocks, 2019). PHOs are the main source of TFAs (up to 60%) and are used as bakery shortening, frying oil and in house¬hold cooking (Taher *et al.,* 2018). Although PHOs

are edible their consumption is associated with increased risk of coronary heart diseases (CHD) (Sartika, 2011; Derbyshire, 2012; Musvosvi and Mhlanga, 2016). The adverse health effects of TFAs in humans are mediated by increased plasma concentrations of low-density lipoprotein cholesterol (LDL-C) and reductions in high-density lipoprotein cholesterol (HDL-C) (Wu *et al.,* 2017), which leads to promotion of inflammation, endothelial dysfunction, insulin resistance and displacement of essential fatty acids from membranes (Mitrou & Lawrence, 2014). CHDs contribute to the global burden of disease especially in low and middle income countries (Derbyshire, 2012; Banseria *et al.,* 2016; Taher *et al.,* 2018; Li *et al,* 2019). It is estimated that 2% increase in energy intake from TFAs is associated with a 23% increase in the risk of heart disease (Banseria *et al.,* 2016). The World Health Organization (WHO) recommends reducing TFAs intake to less than 1% of total daily dietary energy intake (Li *et al.,* 2019). PHOs are the major source of fats/oils in Tanzania by about 60% and its importation has reached about 500,000 Metric tonnes (3ADI+, 2019). The annual consumption of such volumes of dietary source of fat could pose health threat especially CHDs to consumers (Kagiono *et al.,* 2018). However, there is still limited information and awareness regarding the levels of TFAs and their underlying health hazards to the Tanzanian population (Codex Alimentarius Commission, 2017). Tanzania has recorded increased incidences of diet related non-communicable disease (DR-NCD) especially cardiovascular health problems and deaths from 27% in 2010 (Mayige *et al.,* 2011) to 33% in 2016 (Mayige, 2016; URT, 2016; WHO, 2018). The aim of this study was to assess the level of awareness about Trans fatty acids (TFAs) among consumers, edible oil producers and food processors. This study was envisaged to contribute to examining the knowledge of Trans fatty acids with regards to the emerging rise in DR-NCDs and guide policy formulation by the Government and interventions by nutrition stakeholders.

Materials and Methods

Study area

This study was conducted in Morogoro urban and rural districts (Morogoro region; 6°, 49'S, 37°, 40'E). Morogoro region was selected for the study because previous studies have reported that, it was among the three sites (including Dar es Salaam and Hai - Kilimanjaro) which demonstrated a considerably high risk of dying from non-communicable diseases (NCDs) during adulthood (15-59 years) in Tanzania (Mayige and Kagaruki., 2013).

Sample size determination

The sample size was calculated using the Fisher's equation shown below:-

$$n = \frac{z^2 \times p(1-p)}{e^2} \quad (1)$$

Where by n = sample size, p = population proportion 33% (National prevalence of NCDs), e = Margin of error, set 5% for this study and Z = standard variance at a given confidence level, for this study 95%, confidence level = 1.96 (Kothari and Garg, 2014).

Study population

The study population included adult consumers residing in urban and rural households and edible oil producers and food processors.

Sampling procedure

Simple random and purposive sampling approach was used in the study. Morogoro region was randomly selected out of 3 sites (including Dar es Salaam and Hai-Kilimanjaro) reported with high risk of dying from non-communicable diseases during adulthood in Tanzania (Mayige and Kagaruki, 2013). Also,simple random sampling was employed in selecting the two districts (Morogoro urban and rural) out of eight. Furthermore, purposive sampling was employed in selecting two wards (MjiMkuu and Mazimbu) out of 29 wards from Morogoro urban district, and one ward (Kiroka) out of 31wards from Morogoro rural district (Mazimbu and Kiroka wards were the most populated wards in their respective districts, while MjiMkuu ward was selected because it was situated at the town centre). Finally simple random sampling was employed to get streets/villages whereby; four streets (Karume A, Uhuru, Darajani and Boma

A) out of 14 streets were selected from the two wards in Morogoro urban and two (Kiroka and Kiziwa) out of four villages were selected from one ward in Morogoro rural district. The random selection (districts and streets/villages) was done by using a computer program for random number generation. Furthermore a total of 340 households were randomly allocated according to population proportion by using lists of all names of household's heads from village/ street leaders, whereby one adult individual per household was eligible to participate in the study (Fig. 1).

currently working in edible oil and food processing factories (small and large scale) to make a total of 32 participants (Fig. 2). Most of the branded industrial products (e.g. edible partially hydrogenated cooking oils/fats) were manufactured in Dar es Salaam region, and hence large scale processors (edible PHOs and other products such as biscuits and breads), were assessed. Some key questions included their general knowledge regarding TFAs, rich sources, associated health problems, how they are formed, and regulatory issues with regards to TFAs.

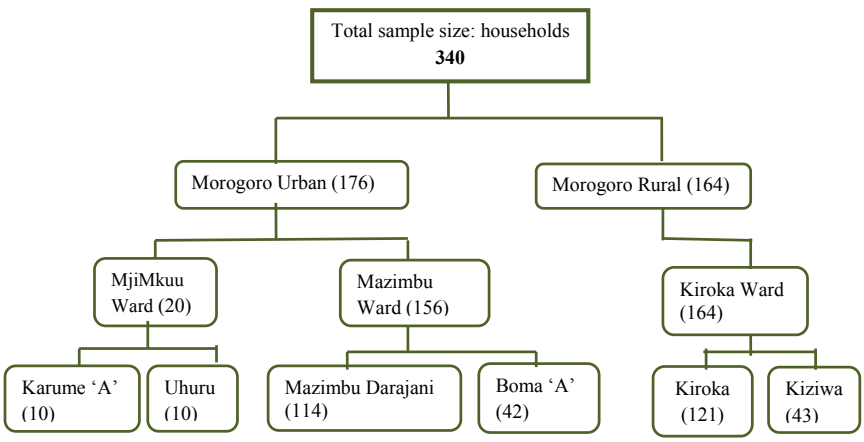

Figure 1: Distribution of consumers

Data collection

Data on Trans fatty acids awareness assessment were collected from 340 respondents representing the group of consumers, 14 participants involved in edible oil and 18 in food production. Structured questionnaires were administered to 176 consumers in Morogoro urban and 164 in Morogoro rural districts. Also there was an addition of some key people (Quality control/production personnel)

Data analysis

Descriptive data were calculated as percentage and frequencies for the variables such as knowledge and awareness. The software for data analysis was SPSS version 20.0 (IBM - SPSS Inc., Chicago, USA) whereby the Fishers exact test was used to determine significance for the relationship between variables. Moreover binary logistic regression was used to test for associations between awareness as dependent

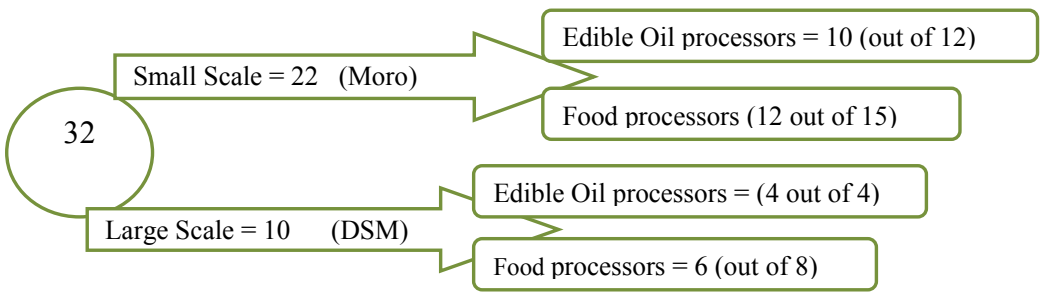

Figure 2: Distribution of Edible oil and Food processors

and residence location, education level as independent variables.

For the consumers' awareness component, each item was given a score of "0" ,"1" or "2" for the incorrect, not sure and correct responses respectively. Hence, the total score for the 5 questions in this section was 10 (0-10) for each participant. For the processors' awareness; each item was given a score of "2" for a correct answer, "1" for "Not sure" and "0" for incorrect or negative response. Hence, the total score for this section of 7 questions was 14 (0–14) for each participant. Participants' overall knowledge was categorized using modified Bloom's cut-off point (Seid and Hussen, 2018).

Results

Demographic information

A total of 340 respondents were enrolled in the study, 176 from Morogoro urban and 164 from Morogoro rural district. About 94% of all respondents were female; 35% of the respondents' age ranged between 31 and 45 years old. Close to 61% of all respondents had attained primary education level; 62% from rural and 59% from urban areas. Generally, farming was the main source of income for 58% of all respondents. In Morogoro rural, 88% of the respondents depended on Agriculture and in Morogoro urban 47% of the respondents depended on small business as their main source of income (Table 1).

Table 1: Demographic information of respondents

Characteristic	Category	Morogoro Urban		Morogoro Rural		Total	
		N=176		N=164		N=340	
		n	%	n	%	n	%
Sex of respondents							
	Male	10	5.7	9	5.5	19	5.6
	Female	166	94.3	155	94.5	321	94.4
	Total	**176**	**100**	**164**	**100**	**340**	**100**
Age of respondents							
	21 -30	54	30.7	48	29.3	102	30.0
	31 - 45	56	31.8	64	39	120	35.3
	46 - 59	34	19.3	28	17.1	62	18.2
	60 and Above	32	18.2	24	14.6	56	16.5
	Total	**176**	**100**	**164**	**100**	**340**	**100**
Education level							
	Informal	19	10.8	40	24.4	59	17.4
	Primary	104	59.1	102	62.2	206	60.6
	Secondary	43	24.4	20	12.2	63	18.5
	Tertiary	10	5.7	2	1.2	12	3.6
	Total	**176**	**100**	**164**	**100**	**340**	**100**
Main source of income							
	Formal employment	23	13.0	5	3.0	28	8.3
	Casual Labour	18	10.2	0	0	18	5.3
	Farming	54	30.1	145	88.4	198	58.2
	Small business	82	46.6	14	8.5	96	28.2
	Total	**176**	**100**	**164**	**100**	**340**	**100**

Knowledge on *Trans* fatty acids (TFAs) among Consumers

Results in Table 2 show that of all (340) surveyed consumers, 97.6% had no information or awareness of Trans fatty acids before and 98.8% had no knowledge on how Trans fatty acids are formed. knowledge on foods with Trans fatty acids and associated health effects among consumers was very low. Only 5% of consumers in MjiMkuu ward, 3% in Mazimbu ward and 0.0% in Kiroka ward had knowledge on foods rich in Trans fatty acids and associated health hazards (Table 2).

Table 2: Consumer's knowledge on *Trans* fatty acids

Variables	Response	Total N=340		Wards					
				Mazimbu N=156		Mji mkuu N=20		Kiroka N=164	
		n	%	n	%	n	%	n	%
Heard of *trans* fatty acids?									
	Yes	8	2.4	5	3.2	2	10	1	0.6
	No	332	97.6	151	96.8	18	90	163	99.4
Knowledge on how *trans* fatty acids are formed?									
	Yes	4	1.2	3	1.9	1	5	0	0
	No	336	98.8	153	98.1	19	95	164	100
Ways on how *trans* fatty acids are formed									
	Industrial process during preparation of Vegetable oils	4	1.2	3	1.9	1	5	0	0
	Formed naturally	1	0.3	0	0	0	0	1	0.6
	No idea	335	98.5	153	98.1	19	95	163	99.4
Knowledge on Foods rich in *trans* fatty acids and associated health effect?									
	Yes	5	1.5	4	2.6	1	5	0	0
	No	335	98.5	152	97.4	19	95	164	100
Who told you about foods rich in *trans* fatty acids and associated health effects?									
	Through studies/ readings	4	80	3	1.9	1	5	0	0
	Health officer	1	20	1	0.6	0	0	0	0

In addition, 98.5% of all consumers had no knowledge about the foods rich in Trans fatty acids and their associated health effects. Furthermore, for few consumers who had knowledge about Trans fatty acids and associated health risks, 80% indicated that their source of information was through individual studies/readings, 20% obtained information from Health Officers. About 99% of consumers in Kiroka ward had never heard of Trans fatty acids followed by consumers in Mazimbu ward (96.7%) and lastly MjiMkuu ward (90%). The

General Consumer's awareness on *Trans* fatty acids

There was no significant difference in awareness on TFAs between consumers in Kiroka and Mazimbu wards (OR: 5.397; p=0.126). There was a significant difference on the level of awareness on TFAs between consumers in Kiroka ward and MjiMkuu ward (OR:=18.111; P=0.020). The odd of being aware was higher for consumers in MjiMkuu and Mazimbu wards than in Kiroka ward (Fig. 3).

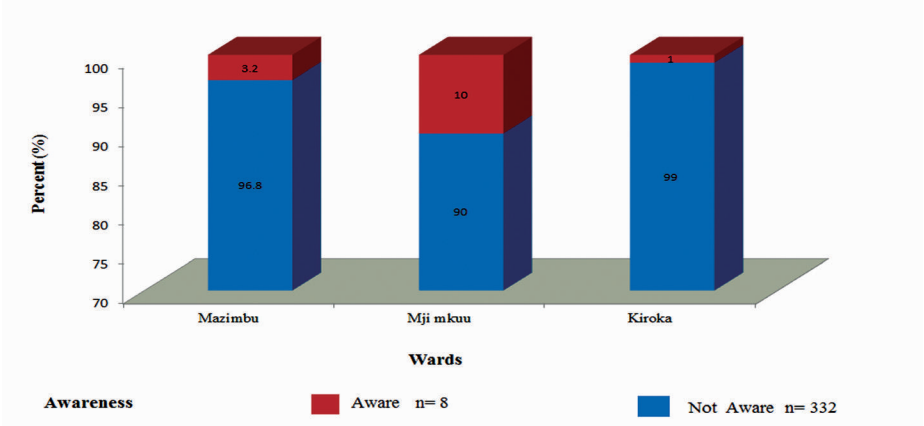

Figure 3: General Consumer's awareness on Trans fatty acids

Knowledge and awareness on Trans fatty acids among edible oil and food processors

About 41% of the edible oil and food processors were aware about Trans fatty acids (TFAs). All (100%) respondents from large scale edible oil and food processors, had prior knowledge about TFAs, followed by the group of small scale food processors who scored 17%, and lastly was the group of small scale oil processors (10%). Only 13% of all surveyed groups had knowledge on how TFAs are formed. About 50% of the group of large scale edible oil processors had higher knowledge on how TFAs are formed compared to other groups (Table 3).

Only 16% of all respondents surveyed, had knowledge on foods rich in TFAs and associated health hazards. More (25%) of the large scale edible oil processors had knowledge about foods rich in TFAs compared to small (17%) and large scale food processors (17%) and small scale edible oil processors (10%). The main source of information was through studies/ readings for 60% of the respondents, and 40% obtained information from health facilities. large scale food processors had the highest (83.3%) knowledge of the association between concentration of TFAs and the level of low density lipoprotein (LDL) - cholesterol in blood followed by the large scale edible oil processors (75%), small scale food processors (17%) and small scale edible oil processors (0.0%) (Table 3).

General Awareness on TFAs among edible oil and food processors

Generally for the group of edible oil, results show that; the awareness of all (100%) edible oil large scale processors on TFAs was above average, followed by 10% of the small scale edible oil processor's group (Fig. 4). The Fishers test results showed a significant difference (P= 0.005) among the small and large scale edible oil processors in terms of general awareness on TFAs.

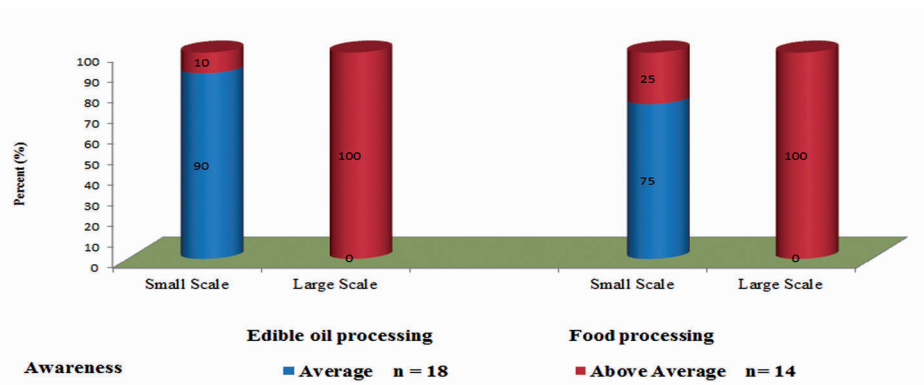

Figure 4: General Awareness on TFAs among edible oil and food processors

Table 3: Consumer's knowledge on *Trans* fatty acids

		Edible oil/Food Processors									
Variables	**Response**	**Total N=32**		**Small scale edible oil N=10**		**Small scale food N=12**		**Large scale edible oil N=4**		**Large scale food N=6**	
		n	%	n	%	n	%	n	%	n	%
Have you heard of *trans* fatty acids?											
	Yes	13	40.6	1	10.0	2	16.7	4	100	6	100
	No	19	59.4	9	90.0	10	83.3	0	0.0	0	0.0
Knowledge on how *trans* fatty acids are formed?											
	Yes	4	12.5	1	10.0	1	8.3	2	50.0	0	0.0
	No	28	87.5	9	90.0	11	91.7	2	50.0	6	100
Ways on how *trans* fatty acids are formed											
	Industrial process	5	15.6	1	10.0	1	8.3	3	75.0	0	0.0
	Not sure	27	84.4	9	90.0	11	91.7	1	25.0	6	100
Knowledge on Foods rich in *trans* fatty acids and associated health effect?											
	Yes	5	15.6	1	10.0	2	16.7	1	25.0	1	16.7
	No	27	84.4	9	90.0	10	83.3	3	75.0	5	83.3
Who told you about foods rich in *trans* fatty acids and associated health effects											
	Health officer	2	40	1	10.0	1	8.3	0	0.0	0	0.0
	Through studies	3	60	0	0.0	1	8.3	1	25.0	1	16.7
Any relationship between concentration of TFAs and the level of LDL - cholesterol in blood?											
	Yes	10	31.3	0	0.0	2	16.7	3	75.0	5	83.3
	Not sure	22	68.8	10	100	10	83.3	1	25.0	1	16.7
Margarine usually contains low proportions of TFAs?											
	Yes	2	6.3	0	0.0	2	16.7	0	0.0	0	0.0
	No	5	15.6	0	0.0	1	8.3	2	50.0	2	33.3
	Not sure	25	78.1	10	100	9	75	2	50.0	4	66.7

For the food processors group, results show that; all large scale processors were more aware on TFAs compared to 25% of small scale food processors whose awareness on TFAs was generally average. Fishers test for association results showed that; there was a significant difference (P=0.009) in awareness among the small and large scale food processors in terms of general awareness on TFAs (Fig. 4).

Awareness among edible oil and food processors on policies/regulations regarding Trans fatty acids (TFAs)

Edible oil and food processors had varied responses (Not sure = 72%, No = 22% and Yes = 6%) regarding presence of regulation (s) in Tanzania or WHO that prompt food processors to limit the amount of TFAs in processed foods. Nevertheless, all (100%) of small scale edible

oil processors of small scale food processors (92%) were "Not sure "about the existence of policy/regulation governing TFAs. Large scale edible oil (75%) and food processors (67%) were not aware of the existence of policy/ regulations governing TFAs.

The surveyed processors were not sure (59%) and had no information (41%) of the existence of policy/regulation that requires food processors to indicate the amount of TFAs content in processed foods (Fig. 6). All large scale edible oil processors and 83% of large scale food processors were 'Not sure' of the existence of policy/regulations on revealing content of TFAs in foods and oils. Similarly, 58%of the small scale food and edible oil processors (50%) had "No idea" about the policy/regulation.

General awareness of edible oil and food processors on policies/regulations regarding Trans fatty acids (TFAs)

Generally 63% of all processors had an average awareness on policies and regulations regarding TFAs. About 83% of all large food processors and 58% of all small scale food processors had an average score on awareness. There was no significant difference (P=0.600) between large and small scale food processors in terms of awareness about policies/regulations on TFAs (Fig. 5). Similarly, 75% of large scale and 50% of small scale edible oil processors had an average score on awareness. No significant difference (P=0.580) was observed between small and large scale edible oil processors in terms of awareness regarding policies/ regulations on TFAs (Fig. 5).

Discussion

The current study has revealed that most of the surveyed consumers had low level of knowledge and awareness on Trans fatty acids (TFAs) and their associated adverse health effects. There were differences between rural districts and urban districts. Most of the respondents from Morogoro rural district had attained Primary School Education whereas those in urban district had attained Secondary school certificate (and even Tertiary education levels).

In the present study, education level was probably one of the factors that contributed to increased level of consumer's awareness in urban compared to their counterparts in rural districts. Similarly, households in urban were more exposed to many sources of information regarding healthy eating such as Television, Radios, newspapers, posters and health centres compared to rural areas. Despite all these sources of information, still they consumed more on unhealthy foodstuffs such as processed and PHOs, less on vegetables and fruits. Meanwhile those rural households despite their low education, they consumed more on minimally processed foods like vegetables,

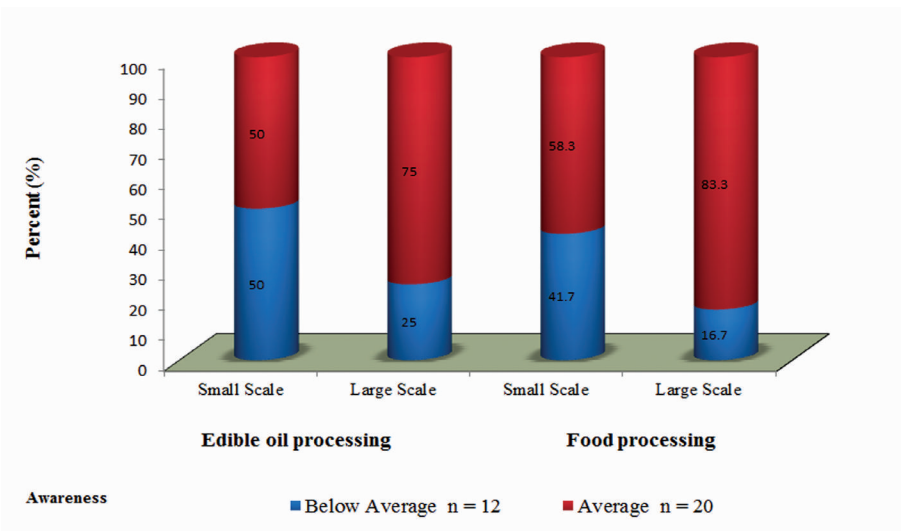

Figure 5: General awareness on policies and regulations regarding TFAs among processors

beans but more on PHOs because it was cheap and readily available. A similar study done by Banseria *et al.* (2016) in central India found that an awareness regarding the presence of TFAs in packaged food items and their harmful effects among participants increased from 62% before being trained and exposed to sources of information regarding healthy eating to 96% after intervention.

Furthermore the observed low level of knowledge and awareness in the current study could be attributed by low nutrition education regarding overconsumption of edible oils, TFAs and their associated health effects in general, also the absence of government policy to limit TFAs in processed foods could be the major factor for lack of awareness and limited control of the amounts and presence in foods. This in turn exacerbates the high level of exposure to TFAs for both urban as well as rural households. A similar study done by Musvosvi and Mhlanga (2016) observed that the level of awareness of consumers on TFAs in Kitwe –Zambia increased with the level of education. Also Pletzke *et al.* (2010) observed that nutrition education was associated with more TFAs knowledge and awareness scores among consumers.

According to the results of the current study, the group of edible oils show that; large scale edible oil processors were more aware on TFAs compared to small scale edible oil processors whose level of awareness on TFAs were just an average. The observed differences in their awareness might be contributed by the fact that; all small scale processors were dealing with Sunflower oil (seed oil) processing of which literature have reported that they are healthy, on the other hand large scale oil processors were dealing with partially hydrogenated vegetable oil (PHOs) either in processing or repackaging, that's why their awareness level were higher, moreover; most previous studies had reported that PHOs from industrial sources contain higher proportional of TFAs due to the process of partial hydrogenation during their preparation (Mozaffarian *et al.,* 2013; Pfeuffer, and Jahreis, 2018; Thornton, 2018).

Furthermore in the current study, results for food processors group showed that; large scale food processors were more aware on TFAs compared to small scale food processors who their awareness level was average; this might be contributed by the fact that most of the personnel involved in large scale food processing attained tertiary education, while majority of the small scale food processors attained primary and only few secondary level of education., This is supported by other studies (Lin *et al.,* 2010; Musvosvi and Mhlanga, 2016) where awareness on TFAs was observed to improve with education. Also being in the large scale processing industry could be another factor that favoured large scale processors on being aware on TFAs than those small scale processors. This instance puts most consumers in Morogoro at risk of diet related non communicable disease especially cardiovascular disease (CVDs) in particular, since most of them consume processed foodstuffs manufactured/prepared either by small or large scale processors.

The findings in current study reported that awareness among all groups of edible oil and food processors towards the country's policies and regulations regarding TFAs were generally average. Moreover, some minor variations were observed, whereby the score for large scale processors were slightly higher compared to small scale processors, besides both group having an average awareness.

The observed moderate awareness of both large and small scale processors regarding policies and regulations on TFAs could be contributed by the fact that in Tanzania, the policies and regulations on TFAs were not yet set in place. This situation predisposes consumers at more risk of non-communicable diseases especially CVDs. The obtained findings are also supported by Li *et al.* (2019) from the study on evidence from global surveillance of TFAs which showed that Tanzania was one among countries in Africa which had not yet set the regulations and policies on TFAs. The current study is also in parallel with another study done by Juma *et al.* (2016) which found that; in sub-Saharan Africa, there is limited research on the application and success of multi-sectoral approach in the formulation and implementation of policies aimed at prevention of non-communicable diseases. Furthermore, findings of the current study is in good agreement with the

World Health Organization (WHO, 2019) which argued that, understanding TFAs sources, the supply chain, stakeholders, regulatory agencies and legal processes will help inform which policy intervention will be most effective and practical to reduce consumption of industrially produced TFAs.

Conclusion

Better nutrition knowledge, especially knowledge about diet-disease relationships, can help promote healthful dietary choices and enhance health literacy among consumers.

Awareness and understanding of different fats to food consumers, edible oil and food processors may also help decrease the risks of diet related non communicable diseases (NCDs) as attributed by Trans fatty acids.

It is recommended that; there is a need to increase awareness regarding the danger of Trans fatty acids among Morogoro households which will reduce or cut down their usage in their diet plans.

A further research to be conducted by considering other factors that might be contributing to the low level of awareness towards Trans fatty acids among households/ consumers and also considering other consumer locations in Tanzania.

It is better for the government through the Ministry of Health Community Development, Gender, Elders and Children in collaboration with other relevant authorities to provide guidance on policy options and steps to design, enact and implement legislative and regulatory actions suitable to the Tanzanian context in order to reduce industrially produced Trans fatty acids in the food supply. However, the results of the current study may be gender biased due to the fact that, most of the participants for the study were women.

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