International Journal of Community Medicine and Public Health
Maakhni G et al. Int J Community Med Public Health. 2019 Nov;6(11):4769-4776
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20195053

Original Research Article

Consumption of the trans fats and fats in adult females in urban and rural areas of Ludhiana: a population-based study

Govind Maakhni*, Shavinder Singh, Deepshikha Kamra

Department of Community Medicine, Christian Medical College and Hospital, Ludhiana, Punjab, India

Received: 13 August 2019
Revised: 17 September 2019
Accepted: 17 September 2019

***Correspondence:**
Dr. Govind Maakhni,
E-mail: govind.cmc@gmail.com

ABSTRACT

Background: In India, fast foods are becoming part of our daily lifestyle. Foods prepared in restaurants are very high in trans fats (TFs). Also, alarmingly about 400,000 tonnes of snacks, which are largely prepared in TFs are consumed every year. According to recent studies, TFs levels are 5 to 12 times higher in the oils consumed in India as compared to the world standard. The WHO recommends that TFs intake be less than 1 percent of total caloric intake. The objective of the study was to assess the consumption of TFs and fats in foods by the population in urban and rural areas.
Methods: This was a community-based cross-sectional study. All adult females above 18 years of age who took an active part in kitchen were interviewed. Their dietary patterns were assessed. The sampling was done using a systematic random sampling technique and 200 participants each in rural and urban areas were selected.
Results: 12 percent participants in the urban area and 9 percent participants in the rural area were exceeding WHO limit of less than 1 percent TFs consumption. The median value of TFs consumption was higher in urban area (0.575 grams/day) than in rural area (0.427 grams/day).
Conclusions: The study concludes that 12 percent participants in the urban area and 9 percent participants in the rural area were exceeding TFs consumption. Therefore, a proactive approach to ensure that these WHO regulations have the full intended effect needs to be taken.

Keywords: Trans fats, Oils, Snacks

INTRODUCTION

Trans fats (TFs), as the name implies, are those unsaturated fatty acids which have at least one unsaturated, non-conjugated double bond in their trans configuration (rather than having these bonds as of the typical cis fats).[1] TFs are preferred in the food preparation modes as it provides favorable characteristics such as consistency and mouth feel. Further, with exposure to air/oxygen, it increases product shelf life.[2] The food manufacturers also use these TFs because they are cheaper in mass production.[3]

Foods prepared in hotels and restaurants are very high in TFs, and we are witnessing an alarming increase in the urban population who eat outside.[4] Especially in modern India, fast foods and street eating joints are becoming part of our lifestyle. Also, alarmingly about 400,000 tonnes of snacks, which are largely prepared in TFs are consumed every year.[5] Major dietary sources of TFs in India are deep-fried fast foods such as samosas, baked products, packed snack foods, margarine and crackers.[5]

The use of TFs does not end here, though the WHO recommends that TFs intake to be less than 1 percent of

total caloric intake.[6] They are also present in sweets, chocolates, spreads, soups, salad dressings and snacks. According to one research, processed foods and oils provide approximately 80 percent of TFs in the diet, compared to 20 percent that occur naturally in food from an animal source.[4] In comparison to the world standard for TFs in oil, the Centre for Sciences and Environment study has reported TFs levels 5 to 12 times higher in oils consumed in India.[7] The Indian National Sample Survey Organization (NSSO), India demonstrates that consumption of biscuits, beverages, salted snacks, processed foods, prepared sweets and other purchased foods ranged from 100 to 427 grams/capita/day from the bottom to the top expenditure class of population; with a mean consumption of 167 grams/capita/day. This is a forewarning of the increasing consumption of snack foods and high-calorie foods in our population.[8]

Though TFs are widely used, TFs are not at all essential for human nutrition. Rather they are hazardous to health. They increase the risk of cardiovascular disease more than any other macronutrient, including saturated fat. TFs are known to exhibit adverse effects, including effects on lipids, endothelial function and inflammation.[9]

TFs intake should be zero, and new technology of hydrogenation of oils should be developed, which produces zero TFs while preserving the desirable properties contributed by TFs.[4] By encouraging food industry in India to attain lower TFs levels by using blends of vegetable oils with lower levels of unsaturation and thus requiring less hydrogenation.[10]

Not surprisingly, most producers and consumers in India lack awareness regarding the negative health impact of TFs.[10] Consumers are unable to identify the contents of foods they are consuming because many foods do not have labels.[11] The street food and snacks vendors which comprises of an unorganized sector are mostly unaware of the regulations to check TFs content in food. The public at large does not have an opportunity to make informed choices which help in decreasing TFs intake as well as a decrease in health risk.[5]

It is felt that there is an immediate need to make public aware of the ill-effects of TFs because India is home to the highest number of atherosclerosis cases in the world.[8] Importantly, in the Indian food-based dietary guidelines, guidelines for reducing TFs need to be included.[10]

The objective of the study was to assess the consumption of TFs and fats in foods by the population in urban and rural areas. Several measures were taken at international and national levels to decrease TFs consumption are unlikely to be successful unless people are actually aware of their daily TFs consumption. Therefore, in this study, knowledge about TFs consumption becomes an important measure to help the community identify their TFs intake. Hence people not only decrease their TFs consumption but also seek healthcare advice at an early stage before TFs have caused serious irreversible health effects.

METHODS

Study design

The present study was a community-based cross-sectional study.

Study population

The study population consisted of adult females above 18 years of age staying in urban and rural field practice areas of the Department of Community Medicine in Christian Medical College, Ludhiana. The total population of the urban area i.e., field Ganj was approximately 20346 and was divided into 5 areas. The total population of the rural area i.e., Lalton was approximately 11716 and was divided into 4 villages which include Lalton Kalan, Khurd, Daad and Dolon. The population primarily consisted of farmers.

Sample size calculation

The sample size was calculated using online software, open epi, version 3, open source calculator. With 8000 population of adult females staying in urban and rural areas, power (α) of 80% and 95% confidence interval (β), with a hypothesized prevalence of outcome factor i.e., use of trans fats as 50%, the sample size was calculated to be 367. This was rounded off to 400 (allowing for 10 % non-response rate).

Inclusion criteria

Adult female above 18 years of age who took an active part in kitchen and household activities. If there were more than two above 18 years' adult females) then adult female who was directly involved in purchasing of food groceries and adult female who was directly involved in cooking in the kitchen. If both criteria were satisfied then whosoever adult female was available and if both were available then younger in age adult female was selected for study.

Exclusion criteria

Subjects below 18 years were excluded from the study.

Sampling method

The sampling was done using a systematic random sampling technique and 200 participants in each rural and urban area were selected. The study included a span of about 18 months it started from April 2017 to 1st week of November 2018. House to house interviews of the study subjects were taken after obtaining an informed consent from the respondents.

Detailed dietary assessment including 24 hours recall for the regular diet and 7 days recall history for the use of edibles (snacks) containing TFs were recorded. TFs reference values of most commonly consumed snacks were taken from previous studies. Because it was not financially feasible to calculate these values by gas chromatography biochemistry lab test and was beyond the scope of the study. Standardized measuring techniques were used to describe the quantity of the food items (snacks) intake, reference of which was taken from a local sweets shop in Lalton Kalan by taking owner's consent where the most commonly consumed snacks and sweets were weighed per piece by the electronic weighing machine. Fats and TFs values of locally consumed cooking oils and desi ghee were taken from the nutritive value labels of the products sold in local markets in 2016, the sources were their manufacturing companies.

TFs of food items consumed were calculated according to the weight of food items consumed by participants.[4,5,8,11,12] TFs of cooking medium i.e., oils and desi ghee were also calculated. After this, TFs of food items and cooking mediums were added and calories were calculated. Calories from 24 hours recall regular diet was calculated and calories per day of food items (snacks) such as samosa, barfi etc. were added.[4,8,13-28] TFs intake as a percentage of total calorie consumption was calculated. The individuals, who consumed TFs equal to or more than 1 percent were labelled as excessive TFs consumers according to WHO.[6] In our study actual intake of TFs may be higher in participants as TFs formed due to reheating of cooking oils have not been quantitatively estimated.

Analysis of outcome

The data was analyzed statistically using EpiData analysis ver 2.2.3 and SPSS v21. Percentages, frequencies, mean, median, standard deviation, Chi-square test and Maan-Whitney U test were used to analyse the results on this study. This study was approved by the institutional research and ethics committee.

RESULTS

The demographic data of the participants of this study is given in Table 1. The median age of participants was 40 years in the rural area and 36 years in the urban area. The average family size was 5 (rounded off 4.98) in rural area and 5 (rounded off 5.27) in urban area. It was found that 13.5 percent of participants were illiterate in the rural area, and 22.5 percent were illiterate in urban areas. The majority (34.5 percent) of participants in the rural area were educated up to secondary stage whereas in urban area majority (38 percent) was educated up to middle stage.

Table 1: Demographic profile of participants.

Demographic characteristics	Rural population	Urban population	Total
Age groups (in years)	**N (%)**	**N (%)**	**N (%)**
15-24	11 (5.5)	17 (8.5)	28 (07)
25-34	52 (26)	70 (35)	122 (30.5)
35-44	55 (27.5)	50 (25)	105 (26.5)
45-54	43 (21.5)	35 (17.5)	78 (19.5)
55-64	27 (13.5)	20 (10)	47 (11.8)
65 and above	12 (06)	8 (04)	20 (05)
Education			
Illiterate	27 (13.5)	45 (22.5)	72 (18)
Primary	0 (0)	3 (1.5)	3 (0.8)
Middle	58 (29)	76 (38)	134 (33.5)
Secondary	69 (34.5)	31 (15.5)	100 (25)
Senior Secondary	26 (13)	19 (9.5)	45 (11.2)
Graduation	18 (9)	23 (11.5)	41 (10.2)
Post-graduation	2 (1)	3 (1.5)	5 (1.2)
Total number of participants	200	200	400

Figure 1 shows that excess trans fats percentage consumption was marginally higher in urban areas participants (12%, CI; 7.5-17%) than in rural area participants (9%, CI; 5.5-13%). This difference was statistically, not significant i.e., p=0.328.

Table 2 shows that the median value of consumption of total calories was significantly higher in rural areas (1899 kcal per day) than in urban areas (1825 kcal per day). The median consumption of proteins was significantly higher in rural areas (72 grams per day) than in urban areas (70 grams per day). The median value of consumption of total trans fats of food items, oils and ghee was marginally higher in urban areas (0.575 grams per day) than in rural areas (0.427 grams per day). The median value of trans fats in snacks consumed was significantly higher in the urban area (0.384 grams per day) than in rural area (0.285 grams per day) as well as shown in Figure 2. Also, the median value of oil trans fats consumption per member was significantly higher in the

rural area (0.0022 grams per day) than in urban area (0.0019 grams per day).

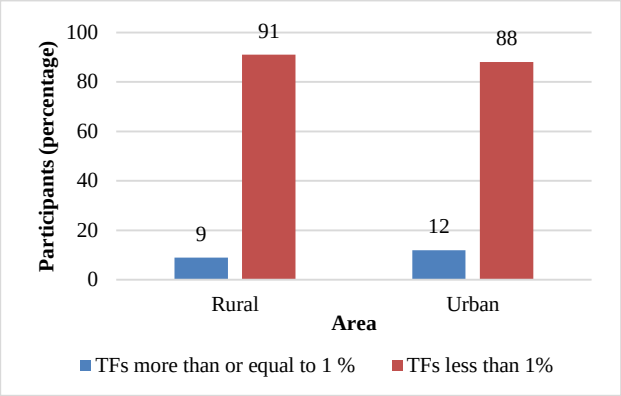

Figure 1: Trans fats consumption in rural and urban areas.

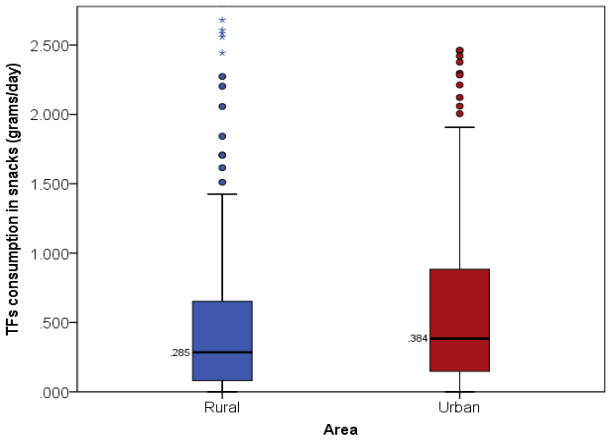

Figure 2: Consumption of TFs in snacks in participants of rural and urban area.

Table 2: Comparison of consumption of trans fats and fats in participants of rural and urban area.

	Area		Mann-Whitney U test statistic	P-value
	Rural (n=200)	Urban (n=200)		
Total calories	1899 (1753-2085)	1825 (1694-1917)	15110.5	<0.001
Proteins (grams/day)	72 (69-78)	70 (68-74)	15971.5	<0.001
Trans fats of snacks, oil and desi ghee (grams/day)	0.427 (0.206-0.928)	0.575 (0.251-1.09)	17796.5	0.057
Trans fats calories (kcal/day)	3.84 (1.85-8.36)	5.17 (2.26-9.79)	17796	0.057
Fats of snacks (grams/day)	1.59 (0.35-6.16)	2.12 (0.84-5.96)	18695	0.258
Trans fats in snacks (grams/day)	0.285 (0.081-0.655)	0.384 (0.148-0.896)	17466.5	0.028
Monthly oil consumption per household (ml/month)	3000 (2000-4000)	4000 (2500-5000)	15158.5	<0.001
Monthly oil consumption per member (ml/month)	625.0 (339.3-833.3)	794.7 (500.0-1000.0)	15525.5	<0.001
Monthly oil fats consumption per household (grams/month)	2724 (1816-3637)	3632 (2270-4540)	14977.5	<0.001
Monthly oil fats consumption per member (grams/month)	568.0 (308.0-757.0)	722.0 (454.0-908.0)	15411	<0.001
Oil TFs consumption per member (grams/day)	0.0022 (0.0011-0.0042)	0.0019 (0.0004-0.0033)	16847	0.006
Monthly ghee consumption per household (ml/month)	250 (0-1000)	500 (0-1000)	16426	0.001
Monthly desi ghee consumption per member (ml/month)	41.7 (0-166.7)	83.3 (0-250.0)	16804.5	0.004
Monthly ghee fats consumption per household (grams/month)	224.5 (0-898.0)	449.0 (0-898.0)	16420	0.001
Monthly ghee fats consumption per member in (grams/month)	37.4 (0-149.7)	74.8 (0-224.5)	16803	0.004
Ghee trans fats consumption per member (grams/day)	0.045 (0-0.18)	0.090 (0-0.27)	16803	0.004

*Figures in bracket are interquartile range (Q1-Q3). Q1 is the first quartile, and Q3 is the third quartile.

Table 3 shows that the highest quantitative consumption was of mustard oil which was 2258 ml per month in the rural area and 2661 ml per month in the urban area households.

Table 4 shows that the highest quantitative consumption was of mustard oil which was 512 ml per month in the rural area and 558 ml per month in the urban area households.

Table 3: Average monthly consumption of the oils and ghee per household in rural and urban areas.

S. No.	Oil and ghee	Rural area (ml)	Oil and ghee	Urban area (ml)
1	**Mustard oil**	2258	Mustard oil	2661
2	**Desi ghee**	514.5	Fortune oil	964.76
3	**Nature fresh oil**	446	Desi ghee	732.08
4	**Saffola oil**	305	Saffola oil	266
5	**Fortune oil**	57.5	Nature fresh oil	115
6	**Canola oil**	46	Canola oil	65
7	**Olive oil**	0	Olive oil	12.5

Table 4: Average monthly consumption of oils and ghee per member in rural and urban areas.

S. No.	Oil and ghee	Rural area (ml)	Oil and ghee	Urban area (ml)
1	**Mustard oil**	512	Mustard oil	558
2	**Desi ghee**	115	Fortune oil	186.76
3	**Nature fresh oil**	96.16	Desi ghee	147.08
4	**Saffola oil**	58.8	Saffola oil	64.8
5	**Fortune oil**	10.52	Nature fresh oil	24.34
6	**Canola oil**	12.13	Canola oil	12.85
7	**Olive oil**	0	Olive oil	2.21

DISCUSSION

This education status seen in this study is consistent with the literacy rate of 76.68 percent in Punjab and 74.04 percent in India.[29]

This study found out that there was a marginally higher percentage of participants, consuming equal to or more than 1 percent energy from TFs in the urban area, i.e., 24 (12 %, CI; 7.5-17), compared to 18 (9%, CI; 5.5-13%) in the rural area. The median TFs consumption was 0.575 grams per day in the urban area and 0.427 grams per day in the rural area. The median total fat consumed was 31.71 grams per day in the urban area and 25.68 grams per day in the rural area.

In 2012-2013, a TFs consumption study by Ghosh et al in low socioeconomic status (SES) population found that 13 percent population of urban area of the northeast district, Gandhi Nagar Assembly (Chanderpuri) consumed excess TFs and 4 percent population of rural area of district Mewat, Haryana.[12,30] This was higher than 12 percent in the urban area and lesser than 9 percent in the rural area in our study. We did not classify the respondents according to SES in our study.

In Ghosh et al study median TFs consumption per consumption unit was 0.670 grams per day in the population of urban area and 0.220 grams per day in the population of rural area. The consumption unit (CU) refers to the average calories consumed by an average adult 60 kg sedentary individual.[30] In their study the median visible fat intake was 41.70 grams per day in the population with upper and middle SES of urban area. The median total fat consumption was 36.90 grams per day in population with low SES of the urban area and 29.50 grams per day in population with low SES of rural area.[12,30] The median TFs consumption in our study on comparison to Ghosh et al study was lower in the urban area and higher in the rural area. The actual intake of TFs in our study might be higher in participants as TFs formed due to reheating of cooking oils have not been quantitatively estimated. The median fats consumption in our study was lower in both the urban and rural area on comparison to Ghosh et al study.

In TFs and fats intake estimation study published in 2012 by Kris et al in the USA, which used 1992-2002. The National Health and Nutrition Examination Survey (NHANES) food database. It was found that in 4760 females of age 20 years and above, the median consumption of TFs was 4.400 grams per day. The median consumption of total fats was 61.80 grams per day.[31]

In 2011, in China, two cities survey for three consecutive days was conducted in urban areas of Beijing and Guangzhou with 24 hours of dietary recall. It was found that mean TFs was 0.530 grams per day in 18 years old and above individuals.[32] This was lower than the median TFs consumption of 0.575 grams per day in the urban area in our study.

In an Irish study by Li et al, among 441 women, mean TFs intake was 1.100 grams per day in 18-35 years old females, 1.000 gram per day in 36-50 years old and 51-64 years old females. The mean fats intake was 78.70 grams per day in 18-35 years old females, 72.80 grams/day in

36-50 years old and 71.90 grams per day in 51-64 years old females.[33] In the 2008 national survey in Canada by 24 hour dietary recall in 10583 females 19 years and above, the mean TFs consumption was 2.870 grams per day.[34] In a 2008-2009 national survey in the UK, by four days dietary recall, it was found that mean TFs intake in 434 women in the UK was 1.600 grams per day in 19-64 years old age group. The mean fats intake in 434 women in the UK was 71.40 grams per day in 19-64 years old age group.[35]

In these studies TFs consumption was higher than 0.491 grams per day median TFs consumption and 28.84 grams per day median fats consumption as reported in our study.[31,33- 35]

In this study the median fat consumed from snacks in the urban area was 2.12 grams per day, which was marginally higher than 1.59 grams per day in the rural area. In Ghosh et al study, the median fat consumed from snacks with low SES in the urban area was 10.80 grams per day and 1.00 gram per day with low SES in the rural area.[30] The median fats consumption in our study on comparison to Ghosh-Jerath et al study was lower in the urban area and higher in the rural area.

The median monthly oil consumption was higher in the urban area, i.e. 4000 ml per household (794.7 ml per member) than 3000 ml per household (625 ml per member) in the rural area. This cooking oil consumption was higher compared to the 2667 ml monthly household consumption in high and middle SES urban area in the study by Ghosh et al.[12]

The median fats in oil consumed by participants were 24.1 grams per day in urban area and 18.9 grams per day in rural area which was similar to study by Ghosh et al in which there were 26.9 grams per day median intake of visible cooking oil per consumption unit in population with low SES of the urban area and 18.7 grams per day with low SES of the rural area.[12]

TFs consumed in cooking oil were 0.0019 grams per day in the urban area and 0.0022 grams per day in the rural area which was similar to the study by Ghosh et al in which household consumption of TFs through the cooking medium was low.[12]

Though there was a statistically higher consumption of quantity of cooking oils (794.7 ml per month per member) in the urban area as compared to rural area (625.0 ml per month per member), however, there was a lesser percentage of TFs in oils consumed in the urban area compared to the rural area. This may be due to the possibility that urban participants read the nutritive value of the cooking oils before purchasing them from local markets.

CONCLUSION

This study concludes that 12 percent participants in the urban area and 9 percent participants in the rural area were exceeding WHO limit of less than 1 percent TFs consumption. The total TFs of food items (snacks), cooking oils and desi ghee consumed were marginally higher in urban area, i.e., 0.575 grams per day as compared to consumption in rural area, i.e., 0.427 grams per day. However, the TFs consumed in cooking oils were significantly less by urban population (0.0019 grams per day) as compared to rural population (0.0022 grams per day). Therefore, a proactive approach to ensure that these WHO regulations have the full intended effect needs to be taken. It is even more imperative in communities, especially in those which have lesser awareness of disease implications of TFs consumption and limited resources for and access to healthier options.

In India, further research by public health professionals needs to be done to assess the TFs consumption in different communities in order to provide key input on its hazardous contribution to health and to get increased support for policies aimed at limiting TFs.

Limitations

This study was a community-based cross-sectional study. The cause-effect association could not be determined by this study. Therefore, further follow-up studies are required to establish these associations, for example, seasonality and TFs intake. TFs values of food items (snacks) had been taken from studies previously conducted because calculating the TFs values of each food item biochemically by gas chromatography was not financially feasible and was beyond the scope of this study. In this study, actual intake of TFs might be higher in participants as TFs formed due to reheating of cooking oils have not been quantitatively estimated and no relevant review was available reporting the effect of reheating and quantity of TFs produced.

ACKNOWLEDGEMENTS

The authors would like to thank God in the first place. Many sincerest thanks and gratitude to everyone who directly or indirectly assisted to complete this research study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Mozaffarian D, Aro A, Willett WC. Health effects of trans-fatty acids: experimental and observational evidence. Eur J Clin Nutr. 2009;63(S2):S5-21.

2. Remig V, Franklin B, Margolis S, Kostas G, Nece T, Street JC. Trans fats in America: a review of their use, consumption, health implications, and regulation. J Am Diet Assoc. 2010;110(4):585-92.
3. Kong L. What a fat debacle: saturated and trans fatty acids effect on health and the future of food manufacturing processes. Baylor University; 2012.
4. Dhaka V, Gulia N, Ahlawat KS, Khatkar BS. Trans fats-sources, health risks and alternative approach- a review. J Food Sci Technol. 2011;48(5):534-41.
5. Karn S, Abraham RA, Ramakrishnan L. Assessment of trans fatty acid content in widely consumed snacks by gas chromatography in a developing country. Food Nutr Sci. 2013;4(12):1281-6.
6. World Health Organization (WHO). Draft guidelines on saturated fatty acid and trans-fatty acid intake for adults and children, 2018 Available at: https://extranet.who.int/dataform/upload/surveys/666752/files/ Draft WHO SFA-TFA guidelines_04052018 Public Consultation(1).pdf. Accessed on 11 Jun 2019.
7. Micha R, Khatibzadeh S, Shi P, Fahimi S, Lim S, Andrews KG, et al. 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;348:1-20.
8. Agrawal A, Gupta R, Varma K, Mathur B. High trans fatty acid content in common Indian fast foods. Nutr Food Sci. 2008;38(6):564-9.
9. Benatar J. The effects of ruminant trans fatty acids and dairy food on cardiovascular disease and cardiometabolic risk. Available at: https://researchspace.auckland.ac.nz/handle/2292/24020. Accessed on 20 October 2016.
10. L'Abbe MR, Stender S, Skeaff CM, Ghafoorunissa, Tavella M. Approaches to removing trans fats from the food supply in industrialized and developing countries. Eur J Clin Nutr. 2009;63:S50-67.
11. Gupta V, Downs SM, Ghosh-Jerath S, Lock K, Singh A. Unhealthy Fat in Street and Snack Foods in Low-Socioeconomic Settings in India: A Case Study of the Food Environments of Rural Villages and an Urban Slum. J Nutr Educ Behav. 2016;48(4):269-79.
12. Ghosh-Jerath S, Singh A, Downs S, Lock K, Lakshmy R, Gupta V, et al. Food and Agriculture, Centre for excellence. Face-cii.in. Available at: http://face-cii.in./. Accessed on 13 November 2016.
13. Fatsecret. Calories in 100 g of plain or buttermilk biscuits and nutrition facts. Available at: https://www.fatsecret.com/calories-nutrition/usda/plain-or-buttermilk-biscuits?portionid=61511&portionamount=100.000. Accessed on 11 June 2019.
14. Fatsecret. Calories in bread pakora and nutrition facts. Available at: https://www.fatsecret.com/diary.aspx?pa=fjrd&rid=1860181. Accessed on 11 June 2019.
15. Haldiram's. Haldirams- Besan Laddu. Available at: https://www.haldirams.com/besan-laddu.html. Accessed on 11 June 2019.
16. My fitness pal. Calorie Chart, Nutrition Facts, Calories in Food. MyFitnessPal. MyFitnessPal.com, 2019. Available at: https://www.myfitnesspal.com/food/calories/haldirams-besan-bhujia-red-pack-167906716. Accessed on 28 May 2019.
17. My fitness pal. Calorie Chart, Nutrition Facts, Calories in Food. MyFitnessPal. MyFitnessPal.com, 2019. [Internet]. Available at: https://www.myfitnesspal.com/food/calories/besan-barfi-658161949. Accessed on 28 May 2019.
18. Haldiram's. Haldiram's Boondi Ladoo. Available at: https://www.haldirams.com/sweets-73/packed-sweet/ boondi-laddu.html. Accessed on 28 May 2019.
19. Fatsecret. Calories in 100 g of Puff Pastry and Nutrition Facts. [cited 2019 May 28]. Available at: https://www.fatsecret.com/calories-nutrition/generic/pastry-puff?portionid=52884&portionamount=100.000. Accessed on 28 May 2019.
20. Nutritionix. Calories in pineapple pastry- 1 small pastry from Nutritionix. Available at: https://www.nutritionix.com/i/nutritionix/pineapple-pastry-1-small-pastry/5930622817919741194e9948. Accessed on 28 May 2019.
21. Nutritionix. Calories in Strawberry Pastry- 1 small pastry from Nutritionix. Available at: https://www.nutritionix.com/i/nutritionix/strawberry-pastry-1-small-pastry/586bd484ca7d28817ec6b15a. Accessed on 28 May 2019.
22. Haldiram's. Haldirams- Soan Papdi. Available at: https://www.haldirams.com/soan-papdi-regular-76.html. Accessed on 28 May 2019.
23. Nutritionix. Calories in Pakoras- 1 pakora from Nutritionix. Available at: https://www.nutritionix.Com/i/nutritionix/pakoras-1-pakora/569015e735443aa75a8d9615. Accessed on 28 May 2019.
24. Nutritionix. Calories in Wheat Rusk from Britannia. Available at: https://www.nutritionix.com/i/Britannia/wheat-rusk/58426db84a87d0c7739290f5. Accessed on 28 May 2019.
25. Haldiram's. Moong Dal- Namkeens-Haldiram. Available at: http://www.haldiram.com/namkeen-and-savories/namkeens/moong-dal. Accessed on 28 May 2019.
26. Gopalan C, Sastri B, Balasubramanian S, Rao B. Nutritive value of Indian foods. Hyderabad, India. Indian Council of Medical Research; 1991.
27. Swaminathan M. Handbook of Food and Nutrition. Bangalore, India. The Bangalore Printing and Publishing Co., Ltd; 2007.
28. ICMR. Dietary guidelines for Indians-a manual. 2nd ed. National Institute of Nutrition, Hyderabad; 2011: 139.
29. Ministry of Health and Family Welfare. NFHS-4,India-Key Indicators. Available at: http://www.rchiips.org/nfhs/pdf/NFHS4/India.pdf. Accessed 11 June 2011.

30. Downs SM, Singh A, Gupta V, Lock K, Ghosh-Jerath S. The need for multisectoral food chain approaches to reduce transfat consumption in India. BMC Public Health, 2015;15(1).
31. Kris-Etherton PM, Lefevre M, Mensink RP, Petersen B, Fleming J, Flickinger BD. Trans fatty acid intakes and food sources in the U.S. Population: NHANES 1999-2002. Lipids. 2012;47(10):931-40.
32. Liu AD, Li JW, Liu ZP, Zhou PP, Mao WF, Li N, et al. Trans fatty acid levels in foods and intakes among population aged 3 years and above in Beijing and Guangzhou Cities, China. Biomed Environ Sci. 2015;28(7):477-85.
33. Li K, McNulty BA, Tiernery AM, Devlin NFC, Joyce T, Leite JC, et al. Dietary fat intakes in Irish adults in 2011: how much has changed in 10 years? Br J Nutr. 2016;115(10):1798-809.
34. Ratnayake WMN, L'Abbe MR, Farnworth S, Dumais L, Gagnon C, Lampi B, et al. Trans fatty acids: current contents in Canadian foods and estimated intake levels for the Canadian population. J AOAC Int. 2009;92(5):1258-76.
35. Pot GK, Prynne CJ, Roberts C, Olson A, Nicholson SK, Whitton C, et al. National Diet and Nutrition Survey: fat and fatty acid intake from the first year of the rolling programme and comparison with previous surveys. Br J Nutr. 2012;107(3):405-15.

Cite this article as: Maakhni G, Singh S, Kamra D. Consumption of the trans fats and fats in adult females in urban and rural areas of Ludhiana: a population-based study. Int J Community Med Public Health 2019;6:4769-76.