Dietary Fats in the India Food system - separating facts from fiction

Pramod Khosla, PhD

Dept. of Nutrition & Food Science,
Wayne State University,
Detroit, MI, USA
(aa0987@wayne.edu)
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Presentation outline…

- Global importance of palm oil
- Dietary fatty acids, lipoproteins and CVD
- Palm Oil and lipoproteins
- Palm Oil as a replacement for *trans* fatty acids
- Indian Dietary Guidelines
- Indian Dietary patterns
- Future research to look at oils/fats within the context of different food systems

Economics/Basic Facts

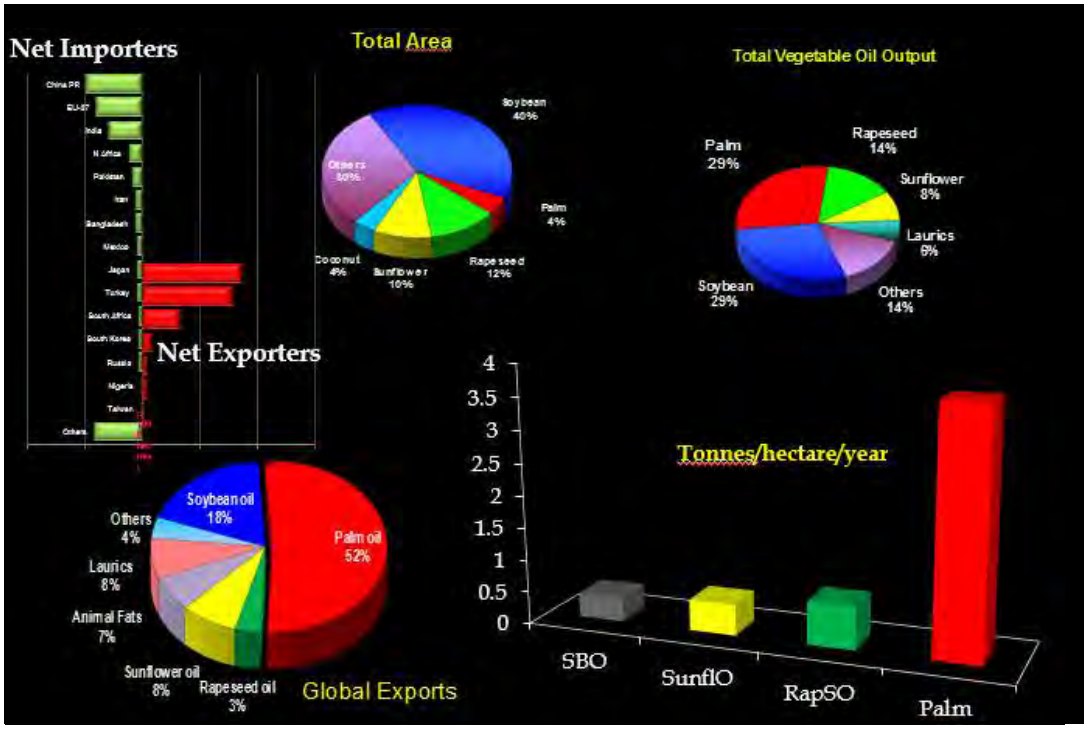
From 1991 to 2017 Global edible oil production went from ~ 84 Million Tonnes (mT) to 214 mT

Production of 17 major oils and fats (in mT) was as follows (%)

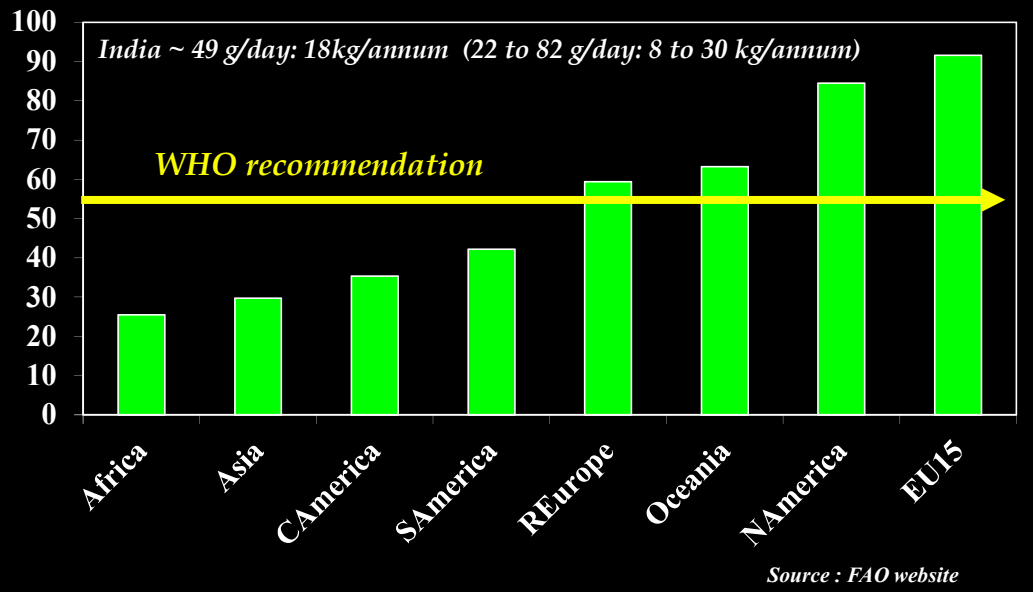
	1991		2016	
Palm Oil	11.9	(14.2%)	64.3	(**30.1%**)
Soybean Oil	16.8	(**20.1%**)	53.6	(25.1%)
Rapeseed Oil	9.5	(11.4%)	24.1	(11.3%)
Sunflower Oil	8.3	(9.9%)	17.1	(8.0%)
Coconut/Palm Kernel Oil	4.3	(5.2%)	9.8	(4.6%)
Olive Oil	1.3	(1.6%)	2.6	(1.2%)
Others/Animal Fats	31.5	(37.7%)	41.8	(19.6%)

Palm Oil overtook Soybean oil as the world's largest produced edible oil in 2004. It accounted for less than 14% of global oils consumption in 1990, 30% in 2016 and will be 50% by 2050.

Global population expected to exceed 9 billion in 2050 (currently at 7.6 billion)
Based on population growth/per capita requirement etc – consumption of oils and fats will >300 mT by 2030 and >500mT by 2045.



Per Capita Fat Consumption - g/day



Why eat/need fat?

- Provides Essential fatty acids
- Carrier for fat soluble vitamins
- Helps absorb other components
- Concentrated source of energy
- Supports cell growth
- Every cell has fat (membrane)
- Brain – fattest organ in body (~60%)

Where fat consumption is low..

- What are the concerns ?

- Are you getting enough calories /malnutrition
- Impact on health (EFA vitamins)
- Suffice to say, any fat will do providing EFA requirement met

- Which fat? Cost involved? Availability? Distribution centres? Government subsidies?

Some parts of India: <20 g/d

Where fat consumption is high..

- Concerns are very different – now consuming excess fat – beyond caloric requirement
- Probably also coupled to excess macronutrient consumption (e.g. sugar)
- Impact on health different … chronic diseases

- Which fat? Are there differences? Cost involved? Availability?

- Regardless – in most cases the underlying defect is often in lipoprotein metabolism and a lot of studies have focused on dietry fat and Cardiovascular disease

Some parts of India: >80 g/d

Dietary fatty acids and cardiovascular disease – a long story…

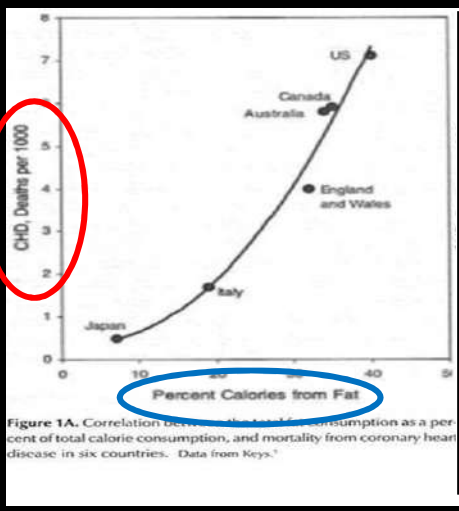
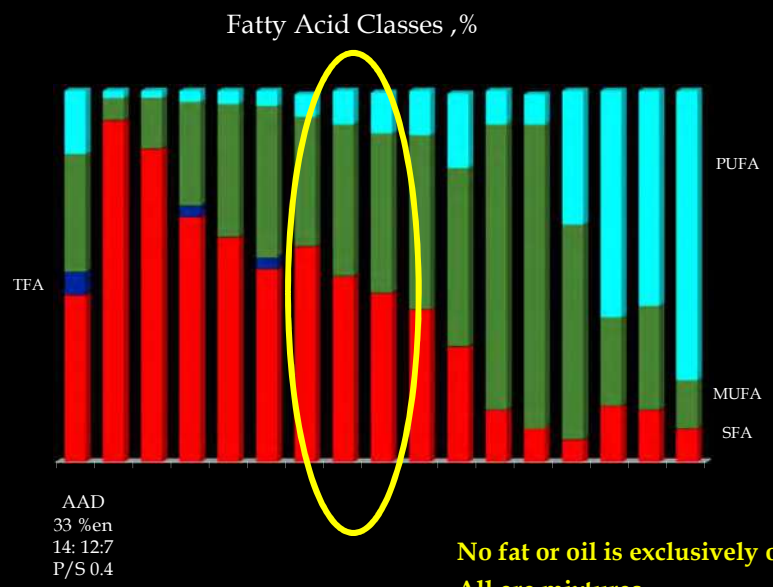


Figure 1A. Correlation be… consumption as a per… cent of total calorie consumption, and mortality from coronary hear… disease in six countries. Data from Keys.[1]

Dietary fat composition: by fatty acid classes



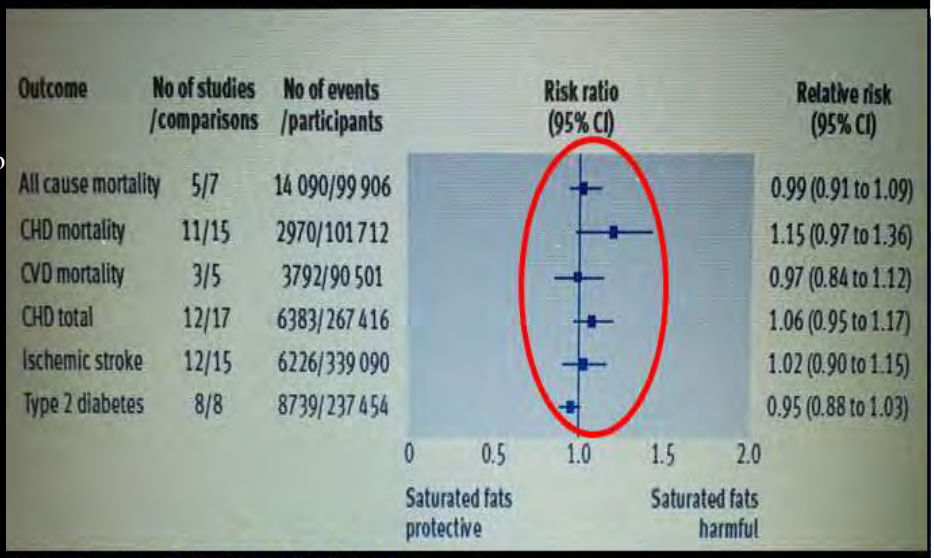
No fat or oil is exclusively one fatty acid
All are mixtures

...several large and well-publicized recent studies suggest that saturated fat does not impact CHD

- **Replacing 5% cals from SFA with PUFA decreased coronary events but not if replacement was MUFA or carbs** [Jakobsen et al., (2009) AJCN, 89: 1425-1432]
- **Only low GI carbs provided benefit, high GI carbs were worse than SFA** [Jakobsen et al., (2010) AJCN, 90: 1764-1768]
- **Meta-analysis of 21 prospective studies. 5-23 yr follow up. SFA intake not associated with stroke, CHD or CVD** [Siri-Tarino et al., (2010) AJCN, 91: 535-546]
- **Meta-analysis found no affect of SFA, leading authors to note that advice to replace SFA with PUFA needs re-evaluation** [Chowdhury et al., (2014) Ann Int Med, 160: 398-406]
- **No evidence for benefits of fat reduction in secondary prevention of CHD and no benefits in advocating PUFA replacement of SFA** [Schwingshackl and Hoffman, (2014) BMJ Open 2014;4:e004487]

Data continues to mount

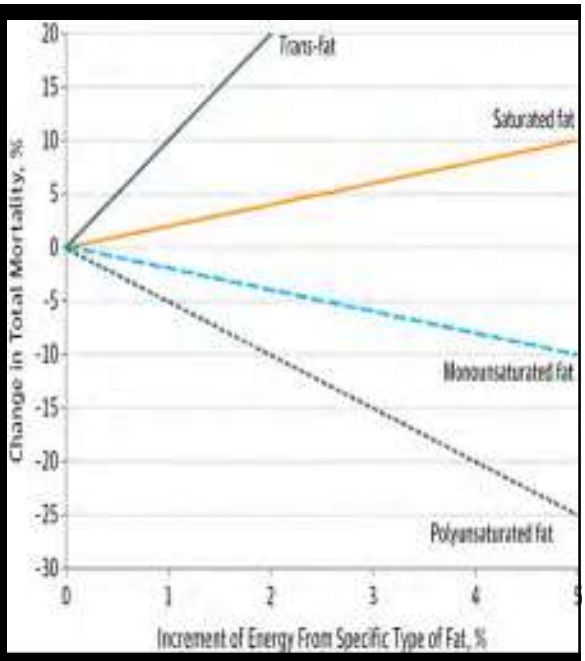
Saturated fats not associated with all cause mortality, CVD, CHD, ischemic stroke, or type 2 diabetes



DeSouza et al (2015) Br. Med J. 351-366

- **Investigation of the association of specific dietary FA with mortality**
- **Data from Nurses Health Study and Health Professionals Study – 125,000 combined subjects**

Replacing 5% of energy from SFA with equivalent energy from PUFA and MUFA was associated with estimated reductions in total mortality of 27% and 13%, respectively

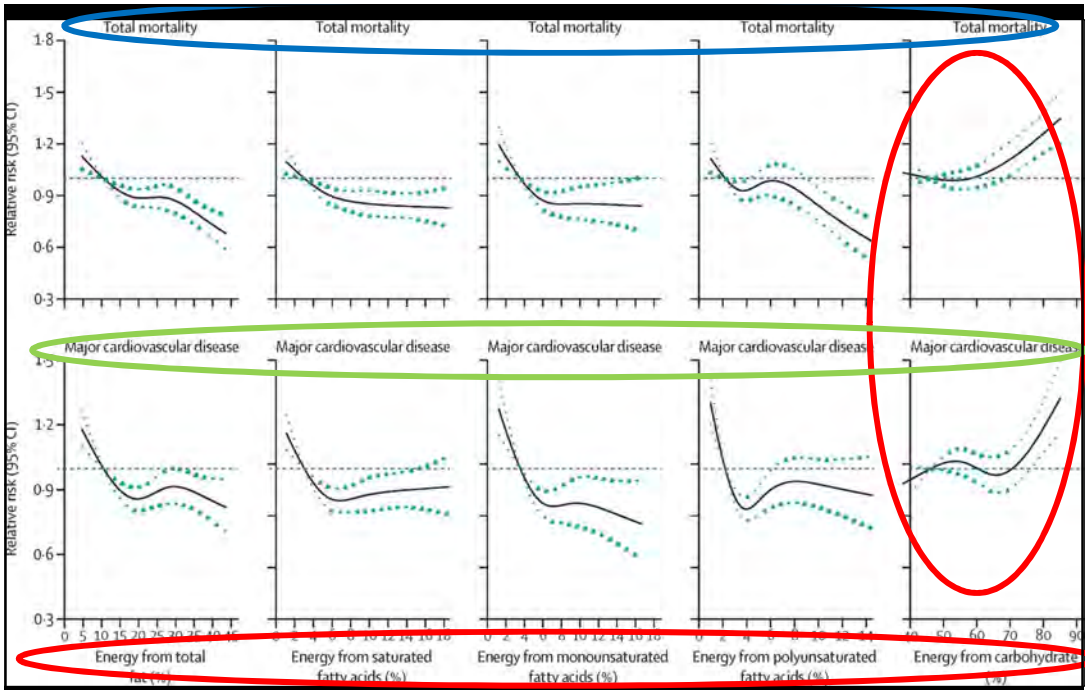


Wang et al, (2016) JAMA Intern Med.176:1134-1145

Associations of fats and carbohydrate intake with cardiovascular disease and mortality in 18 countries from five continents (PURE): a prospective cohort study [Lancet (2017), 390: 2050-2062]

- Prospective Urban Rural Epidemiology (PURE) Study
- Data from 18 countries (including India). Median follow up 7.4 yrs. Diet data from 135,335 individuals
- Primary outcomes – total mortality and cardiovascular events (fatal CVD, non-fatal MI, stroke, heart failure)

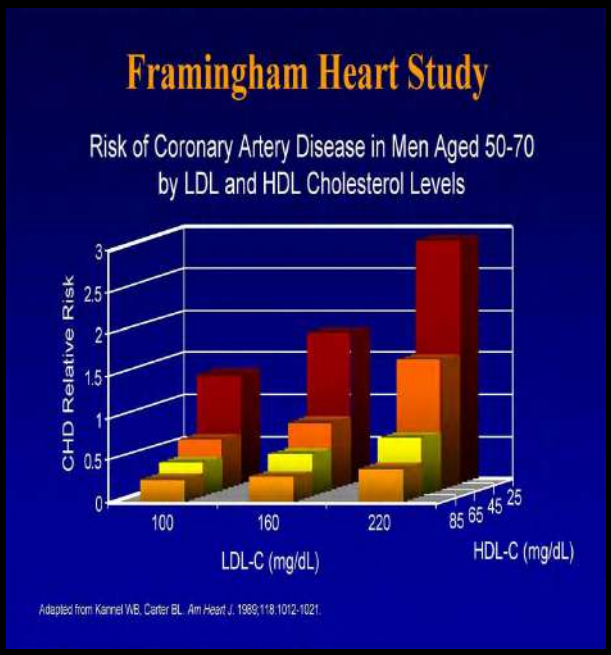
•Higher saturated fat intake (13% en vs 3% en) associated with lower risk of stroke
•Total fat, saturated and unsaturated fats not significantly associated with MI or CVD mortality
•Higher carbohydrate intake associated with higher risk of total mortality



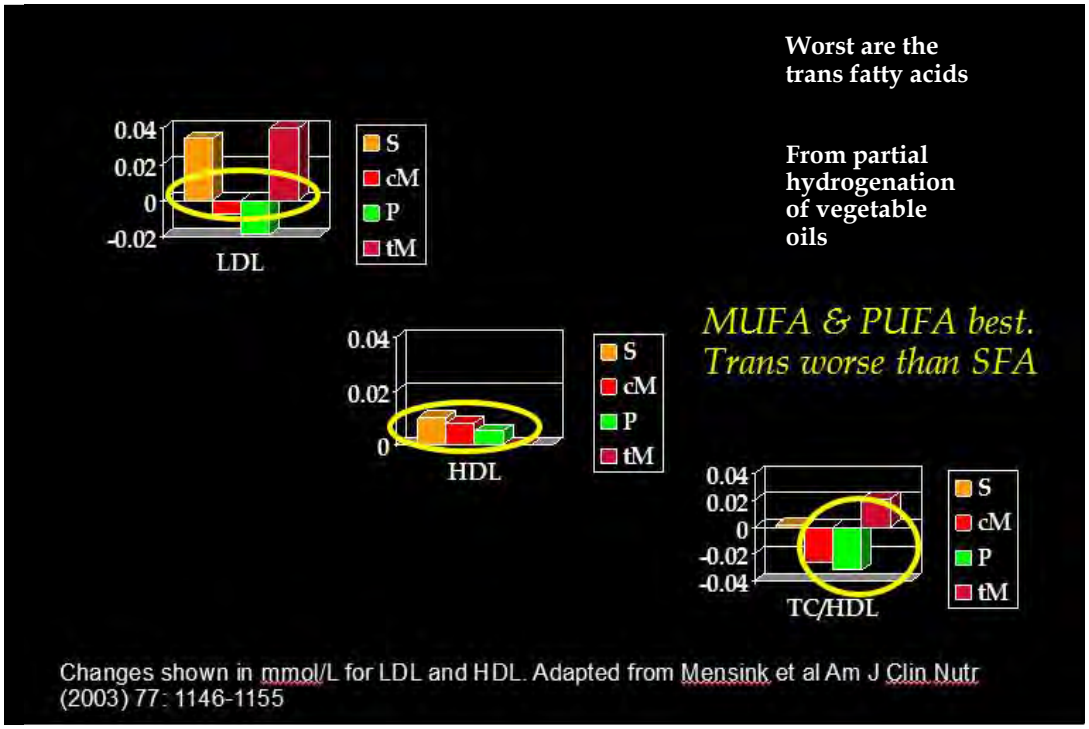
PURE study [Lancet (2017), 390: 2050-2062]

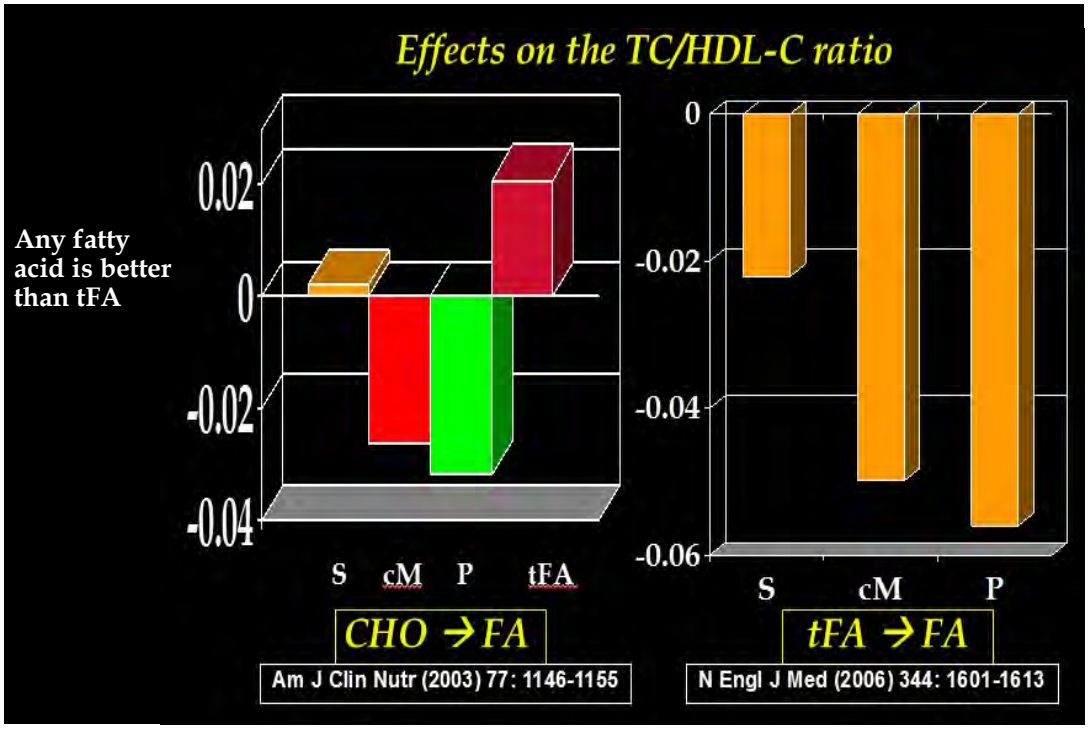
…CVD difficult to measure .. So plasma lipoproteins are easily measured biomarkers to assess risk

LDL (+)
HDL (-)



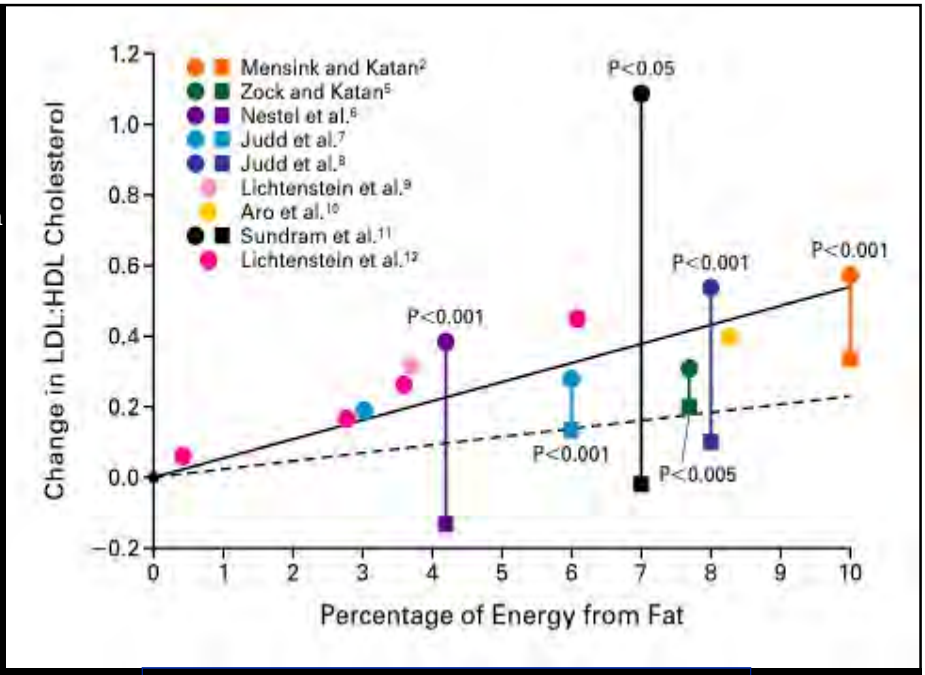
…since high levels of LDL increase CHD risk while high levels of HDL decrease risk….what are the effects of dietary fatty acids on lipoprotein cholesterol?


Worst are the trans fatty acids
From partial hydrogenation of vegetable oils
MUFA & PUFA best.
Trans worse than SFA
0.04
0.02
0
-0.02
LDL
S
cM
P
tM
0.04
0.02
0
HDL
S
cM
P
tM
0.04
0.02
0
-0.02
-0.04
TC/HDL
S
cM
P
tM
Changes shown in mmol/L for LDL and HDL. Adapted from Mensink et al Am J Clin Nutr (2003) 77: 1146-1155


Effects on the TC/HDL-C ratio
Any fatty acid is better than tFA
0.02
0
-0.02
-0.04
S
cM
P
tFA
CHO → FA
Am J Clin Nutr (2003) 77: 1146-1155
0
-0.02
-0.04
-0.06
S
cM
P
tFA → FA
N Engl J Med (2006) 344: 1601-1613

Though both tFA and SFA are a source of solid fats

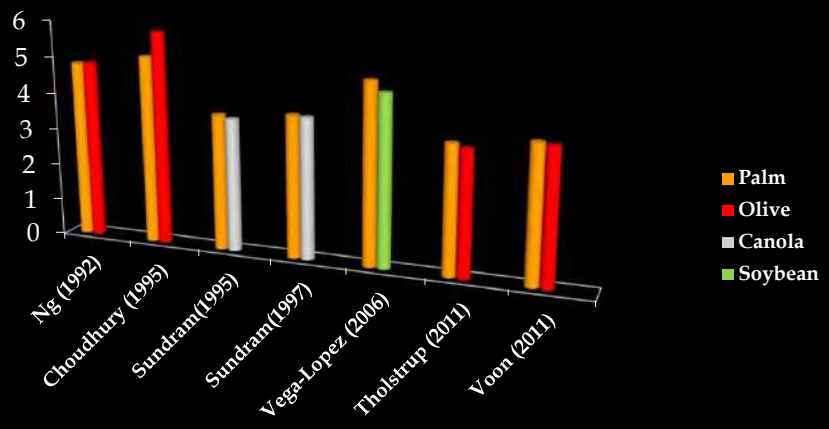
tFA have worse outcomes than SFA



Ascherio et al, (1999) N Engl J Med 340: 1994-1998

…effects of palm oil on the ratio of TC/HDL-C?

Palm Olein and MUFA-rich Oils exert similar effects on the ratio of Total cholesterol to HDL cholesterol (TC/HDL-C) in human subjects



https://www.tandfonline.com/doi/abs/10.1080/09637486.2018.1504009?journalCode=iijf20

Palm oil consumption increases LDL cholesterol compared with vegetable oils low in saturated fat in a meta-analysis of clinical trials

Sun et al, (2015) J. Nutr. 145: 1549-1558

Palm oil and blood lipid related markers of cardiovascular disease: a systematic review and meta-analysis of dietary intervention trials

Fattore et al, (2014) Am J. Clin Nutr. 99: 1331-1350

Synopsis of meta-analysis

- 51 studies; 1526 volunteers (2/3 men); ages 16-70 y
- Studies from Australia, Canada, China, Denmark, Finland, France, India, Malaysia, Netherlands, Norway, Scotland, South Africa, Spain, Thailand, USA
- Feeding times 2 to 16 wks
- Studies in healthy volunteers who were normocholesterol-emic, hypercholesterolemic as well as n/h subjects
- Dietary fat content 28% to 53% of total calories (test fat 4% to 43% of total calories)

Fattore et al, (2014) Am J. Clin Nutr. 99: 1331-1350

Effects on plasma lipoproteins of substituting various fatty acids with palm oil

	TC	LDL	VLDL	apoB	HDL	ApoAI	TG	Lp(a)	LDL/HDL	TC/HDL
Stearic	I	I	N	I	I	I	N	N	I	N
Lauric + Myristic	D	N	N	N	D	D	N	N	N	
MUFA	I	I	N	I	I	N	N	N	N	N
PUFA	I	N	N	I	I	I	N	N	N	N
transFA	N	N	N	D	I	I	D	N	N	D

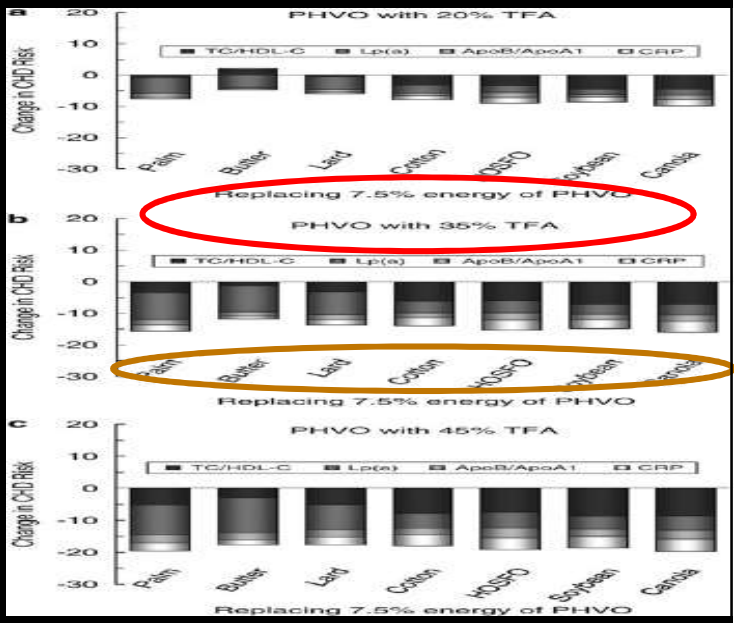
I- increase, D – decrease and N – no significant change

Adpated from Fattore et al, (2014). Am J Clin Nutr 99: 1331-1350

Fattore et al, (2014) Am J. Clin Nutr. 99: 1331-1350

With respect to trans fats

Any fat is better !



…so how much palm oil can you consume given this data

% calories from SFA	% calories from total fat				
	20	25	30	35	40
5	54	43	36	31	27
6	65	52	43	37	32
7	76	61	51	43	38
8	87	69	58	49	43
9	97	78	65	56	49
10	100**	87	72	62	54

Most current guidelines say ~10% cals SFA are OK.

So for 35% calories from fat, 62% of total fat can be PO

For 30% calories from fat, 72% of total fat can be from PO etc.

Khosla (2006) J Agro Food Ind. 17: 21-23
Hayes and Khosla, Eur J Lipid Sci Tech (2007) 109: 453-464

…so what are the Indian Dietary Guidelines?

- Total fat: 15-30% total calories (IDG) (DGAI)
- SFA: <10 % total calories (IDG) (DGAI)
- n6 PUFA: 3-7% total calories (IDG) 5 -8% total calories (DGAI)
- n3 PUFA: > 1% total calories (IDG) 1 -2% total calories (DGAI)
- MUFA: none (IDG) 10-15% total calories (DGAI)
- Trans FA: none (IDG) <1% total calories (DGAI)

IDG Indian Dietary Guidelines, Indian Council of Medical Research 1989, 2009
DGAI Consensus Dietary Guidelines Asian Indian 2011

Gulati et al, (2017) Curr. Diab Rev. 13, 438-443

…so

- **If total fat: 15-30% total calories**
- **and SFA are to be <10 % total calories**

Then 100% - 72% of the dietary fat can be from palm oil

…but theory and practice are entirely different

Fats and oils are not consumed solely in isolation but are part of numerous different Indian dietary patterns

So what do we know about Indian dietary patterns?.....not much

- **Studies from USA in South Asians living there**
- **Metabolic syndrome and Atherosclerosis in South Asians living in America (MASALA study)**
- **Two distinct dietary patters "Western" and "Vegetarain"**
- **Western pattern: added fat, coffee, sugar, alcohol, fish, fried snacks, high-fat dairy, pizza, potatoes, poultry, red meat**
- **Vegetarian pattern: SSB, legumes, nuts, rice, snacks**
- **Vegetarian pattern associated with lower HDL-C**
- **Both patterns associated with adverse medical outcomes**

Gadgil et al, (2014) J. Acad. Nutr. Diet. 114, 238-243

Metabolic Syndrome:

3 out of 5

low HDL-C
high TG
high BP
high blood glucose
large waist circumference

in South Asians in UK …

- Three distinct patterns identified
- "Eastern pattern", "Western pattern", 'Mixed pattern"

Garduno-Diaz SD, Khokkhar, S. (2013) J. Hum. Nutr. Diet. 26, 144-155

- **in Malaysia…**
- Ongoing PATCH clinical trial in maintenance Hemodialysis patients
- Four different dietary patterns identified – Home based pattern; Eating out sugar sweetened beverage-based pattern; Eating out rice-based pattern and Eating out noodle-based pattern

Sulaheen et al, (2019) unpublished data

…so what does this all mean?

- Recently Astrup et al. with reference to the WHO guidelines of dietary fat, saturated and tarns fat suggested a new approach
- Need to focus on the food matrix (dietary pattern)
- SFA (or any FA) effect may depend on the food source
- All dietary fats are not the same : SFA in foods with varying composition and structure e.g. meat, milk, oils, chocolate
- SFA can be in food sources with other components of varying degrees – e.g. simple sugars, proteins
- So perhaps "one size fits all' message is not sufficient in terms of guidelines based simply on calories

Astrup et al, (2019) BMJ, 366, I4137

Summary

Palm Oil – serves a multitude of nutritional needs….

Supply of palm oil makes it *the* important player globally and is an important factor in global food security

Fatty acid profile of palm eliminates need for hydrogenation. Current recommendations for dietary fat (25-30% calories) and saturated fat (~10% calories) allow for 60-70% of dietary fat from palm oil

Effects of palm oil per se, probably influenced by food matrix, food source as well as specific dietary patterns.

Future research should factor this into design rather than simply look at oil vs oil substitutions.