

Amaravathi Popular Science Series



Dietary Fat Intakes and Coronary Heart Disease (CHD) risk

Dr B Sesikeran



Andhra Pradesh Akademi of Sciences
Advancement of Science for Society

About the Amaravathi Popular Science Series



Amaravathi Popular Science Series launched by Andhra Pradesh Akademi of Sciences APAS with the feasible objective of delivering basic information along with illustrative web based references on various topics related to popular science and technologies. The core belief that the Executive committee of APAS, shares and wish the readers to comprehend is: "The forthcoming is going to be good, and science and technologies are the assisting potencies that will help make it better". No matter what one does, they need to be able to think that there are basic principles of science even at popular level that are to be learnt both for acting, reacting and understanding the surroundings. It is expected that this popular science series will enable people to meet this objective. This series aspires further stimulation of the Gray Matter. We talk now a days more on "Smart works" - smart cities, smart technologies etc., and it does mean that hard core technologies are driving behind, to make us adopt the smart paths.

As the Editor of publications of APAS, Educator and as a Scientist, I care only that more and more people are scientifically literate. The more informed people are, the more empowered are the people, who can think for themselves in a better manner, and possibly the more representative our society will be.

The series is intended to take up publications on all aspects that help the penetration of popular science at all levels. After all, the information enriched society is a knowledge society and that shall lead to smartness. An illustrative list of themes proposed to be part of this series includes - interrelated to Earth, Environmental, Natural disasters, Space applications, Astronomy, Mathematics, Antarctica, Basic Sciences, Rivers, Oceans, Health, nutrition, Rural and Urban aspects, Social Sciences, etc... APAS welcomes suggestions and offers from potential authors to contribute articles under this series- Amaravathi Popular Science Series.

I thank Dr. B. Sesikeran, Former Director, National Institute of Nutrition, for readily agreeing to contribute under these series for the benefit of the society.

I V Muralikrishna

Editor of Publications, APAS

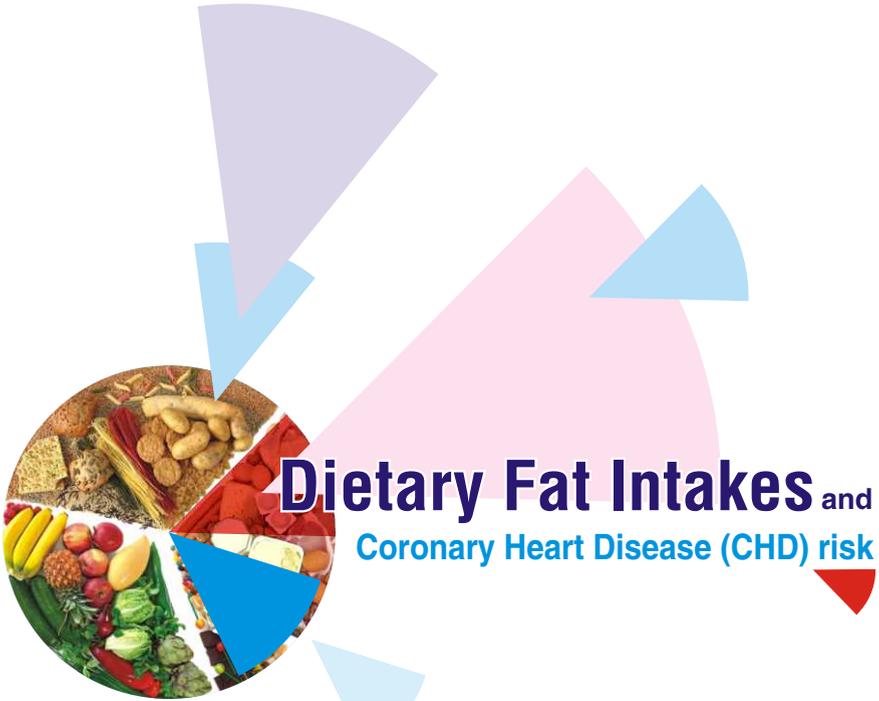
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Date: 21-1-2016

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Published by:

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Acharya Nagarjuna University Campus
Nagarjunanagar-522 510, Guntur, Amaravathi
Andhra Pradesh

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About APAS

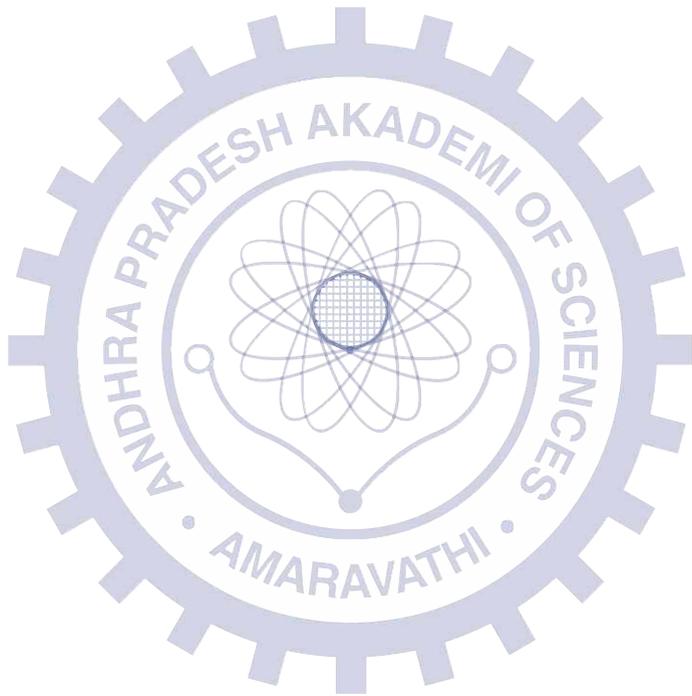
The “Andhra Pradesh Akademi of Sciences” (APAS), come into existence with the initiative of the great visionary Sri P.V.G. Raju, the then Education Minister, Govt. of Andhra Pradesh, who mooted the formation of a forum for all scientists and researchers in this state. The “Andhra Pradesh Akademi of Sciences (APAS)” was founded in 1963, comprises distinguished Scientists, Engineers, Technologists including Medical fraternity covering the entire spectrum of Science and Technology disciplines.

The aims and objectives of the Akademi are mainly the advancement of science in Andhra Pradesh by providing a forum for discussing the scientific developments, propagating scientific knowledge among the people and publication of books and Journals on Science.

Consequent to the Andhra Pradesh reorganization Act, 2014, the Andhra Pradesh Akademi of Sciences is also bifurcated into Andhra Pradesh Akademi of Sciences (APAS) and Telangana State Akademi of Sciences (TSAS). The General Body elected the New Executive Council to A.P. Akademi of Sciences, which has started functioning independently with effect from 30th April, 2015, under the presidency of Dr. B.L. Deekshatulu. The Akademi has decided to bring out Publications under Amaravathi Popular Science Series and I appreciate the efforts of Dr. I.V. Muralikrishna, Editor of Publications, initiated in this direction. The first Publication in these series entitled “Earthquakes” will be released soon. I thank Dr. B. Sesikeran former Director, National Institute of Nutrition, for readily agreeing to contribute to this second publication.

Prof. K.R.S. Sambasiva Rao
Hon. Secretary, APAS

Date: 20-1-2016



APAS

Dietary fat intakes and Coronary Heart Disease (CHD) risk



Cardiovascular Diseases (CVD) are the number one cause of death globally and constituted about 31% of all global deaths in 2012. Of these deaths, an estimated 7.4 million were due to coronary heart disease and 6.7 million were due to stroke.

82% of deaths due to Non Communicable diseases are in low and middle-income countries and 37% are due to CVDs. (WHO, Jan 2015). In India CVD was the largest cause of deaths in males (20.3%) as well as females (16.9%) and led to about 2 million deaths annually. (Registrar General of India. 2009.)

Addressing lifestyle factors like unhealthy diet and obesity, physical inactivity and harmful use of alcohol and tobacco can prevent most cardiovascular diseases. One of the leading factors that contribute to CVD risk is dyslipidemia or an unfavorable lipid profile. Dietary fat intakes have been implicated and considered as a modifiable factor. In recent years there has been a lot of research that has implicated carbohydrate intakes as well as decreased physical activity as factors that override the importance of dietary fat as the key contributor.

The basic nature of dietary fats

Fats are made up of two components, (a) Fatty Acids and (b) Glycerol. The fatty acids have a chain of carbon atoms that may range in number from 4 to 24. Fatty acids and thereby fats which have carbon chain of lengths less than 6 are short chain fatty acids, those with 6 to 12 Carbon atoms are medium chain fatty acids and the ones with 14 to 24 are called long chain fatty acids.

These carbon atoms are connected with each other with single bonds and are called Saturated Fatty Acids (SFA) If there are any double bonds in between then they are categorized as unsaturated fatty acids. If there is a single double bond then it is a

Mono Unsaturated Fatty Acid (MUFA) and if there is more than one double bond then they are called Poly Unsaturated Fatty Acids (PUFA).

In PUFA if the double bond is present on the 6th Carbon atom from one end (methyl end) of the carbon chain it would be a n6 or omega 6 fatty acid and if it is located in the 3rd Carbon atom it is called n3 or Omega 3 fatty acid.

These double bonds are mostly in a cis-configuration i.e. the Hydrogen atoms are on the same side. However when unsaturated liquid oils are partially hydrogenated it changes to Trans i.e. the hydrogen atoms would be on opposite sides. Such fats are known as Trans-fat which causes the maximum harm to the body by increasing heart disease risk as well as an adverse affect on many metabolic functions and causes inflammation. (Ghafoorunissa 2008).

The n6 fats available from vegetarian sources like sunflower, safflower, rice bran etc. contain the shorter chain Linoleic acid that gets converted in the body into the longer chain Arachidonic Acid. Similarly the veg version of n3, which is alpha Linolenic Acid, gets converted to long chain n3 PUFA, DHA and EPA in the body. DHA and EPA are also readily available from fish and fish oils. These are required for many cell membrane functions, known to reduce the risk of clot formation (Ghafoorunissa 2002) in the blood and helps in brain development in the growing brain of foetus and young children as well as brain function. The fatty acid composition of some of the commonly used oils are given in the table

Approximate fatty acid composition of dietary fats and oils consumed in India (% of total fatty acids)

Fats/ oils	SFAs*	MUFAs**	LA /n6	ALA /n3
High (medium chain) SFAs				
Coconut	92	6	2	-
Palm kernel	83	15	2	-
Butter/Ghee	68	29	2	1
High SFAs & MUFAs				
Palmolein	39	46	11	<0.5
High MUFAs & Moderate LA				
Groundnut	19	41	32	<0.5
Rice bran	17	43	38	1
Sesame	16	41	42	<0.5

Fats/ oils	SFAs*	MUFAs**	LA /n6	ALA /n3
High LA				
Cottonseed	24	29	48	1
Corn	12	35	50	1
Safflower	9	13	75	-
Sunflower	12	22	62	-
LA & ALA				
Soybean	14	24	53	7
Canola	6	60j	22	10
Mustard/rapeseed	4	65	15	14
Flaxseed	10	21	16	53
High TFAs				
Vanaspati	46	49	4	-

* Saturated Fat; ** Mono Unsaturated Fat;

(From Recommended Dietary Allowances for Indians ICMR publication 2011)

The recommended relative intakes of various types of fats are 1/3 saturated fat, 1/3 MUFA and 1/3 PUFA. The PUFA should be comprised of at-least 20%, as n3 while the rest could be n6. It can be seen from the table that no single oil can provide all the different types of fatty acids in the desired proportion.

It is recommended that one should take a variety of oils of which at least 25% should come from a n3 containing oil like soybean oil, Canola, Mustard or flaxseed oils. It is preferable to consume the different varieties of oil by rotation rather than mixing. While olive oil is a MUFA rich oil (>70%), tropical oils like groundnut, rice bran, sesame, mustard and palm oils also contain almost 40 to 60% of MUFA and will be able to meet our RDA.

Lipid Profiles of Indians

Genetically and due to the high carbohydrate content of our diets our lipid profiles are unlike that of western countries. Our total cholesterol levels are generally not very high but our LDL cholesterol is made up of small sized particles (small dense LDL) and the triglyceride levels are also high. These are known to be associated with a higher risk of heart diseases. (Kulkarni et al 1999)

We also have lower levels of the HDL or good cholesterol which can be increased only through good physical activity or regular exercise. The above lipid profile renders us vulnerable to atherosclerosis and the consequences thereof. Our lipid profiles cannot be regulated only with modification of our fat intake but primarily by lowering the intake of highly refined and easily digestible carbohydrates and increasing physical activity.

The recommended intake of fats for a sedentary adult male is about 25 gm. of visible fat / day and about 20 gm. for a sedentary adult female. One should take into consideration that all sources of food that we eat particularly processed foods and snack foods contain a large amount of fat.

Recommendations for dietary fat intake in Indians

Age/Sex/ Physiological Groups	Physical activity	Minimum level of Total fat (%E)	Fat from foods other than visible fats %E	Visible fat	
				%E	G/p/d
Adult Man	Sedentary				25
	Moderate	20	10	10	30
	Heavy				40
Adult Woman	Sedentary	20			20
	Moderate		10	10	25
	Heavy	20			30
	Pregnant women				30
	Lactating women		10	10	30
Infants	0 - 6 months	40-60	Human milk		
	7 - 24 months	35	10	25	
Children	3 - 6 years				25
	7 - 9 years				30
Boys	10 - 12 years				35
	13 - 15 years	25	10	15	45
	16 - 18 years				50

Recommendations for dietary fat intake in Indians

Age/Sex/ Physiological Groups	Physical activity	Minimum level of Total fat (%E)	Fat from foods other than visible fats %E	Visible fat	
				%E	G/p/d
Girls	10 - 12 years				35
	13 - 15 years				40
	16 - 18 years				35

(From Recommended Dietary Allowances for Indians ICMR publication 2011)

Recommendations for Type of Visible Fat

1	<p>Use correct combination / blend of 2 or more vegetable oils (1:1)</p> <p><i>Oil containing LA + oil containing both LA and ALA</i></p> <p>Groundnut / Sesame/ Rice bran/ Cottonseed + Mustard/ Rapeseed Groundnut /Sesame/ Rice bran/ Cottonseed + Canola Groundnut / Sesame/ Rice bran/ Cottonseed + Soybean Palmolein+ Soybean Safflower / Sunflower + Palm oil/Palmolein+ Mustard/ Rapeseed</p> <p><i>Oil containing high LA + oil containing moderate or low LA</i></p> <p>Sunflower / Safflower + Palmolein/ Palm oil / Olive Safflower / Sunflower + Groundnut / Sesame / Rice bran/ cottonseed</p>
2	Re Limit use of butter/ghee
3	Avoid use of PHVO (partially hydrogenated vegetable oils) as medium for cooking / frying
4	<p>Replacements for PHVO</p> <p>Frying: oils which have higher thermal stability -- palm oil/ palmolein sesame, rice bran, cottonseed -- single / blends (home /commercial)</p> <p>Bakery fat, shortening, Mithai / Indian sweets etc -- Food applications which require solid fats: coconut oil/ palm kernel oil/ palm oil / palmolein/ palm stearin and / their solid fractions and / their blends</p>

(From Recommended Dietary Allowances for Indians ICMR publication 2011)

Data from surveys conducted by the National Nutrition Monitoring Bureau (NNMB- www.nnmbindia.org) have shown a wide variation in the intakes of fat across the country. We have rural low socioeconomic groups where the intakes are well below the RDA, i.e. 6 gm to 22-gm/ adult/day. They are suffering from chronic energy deficiency and need to increase their fat intakes.

In the middle and upper income groups in urban areas the intakes are more than the recommended i.e. 22 to 45 gm. This is contributing to overweight, obesity, and the chronic degenerative diseases; hence their intakes should be curtailed. In combination with decreased physical activity, a high carbohydrate intake and reduced energy expenditure the prevalence of diseases like diabetes, hypertension, heart attacks and cerebral strokes have gone up. Some forms of cancer like prostate cancer in the male, breast and endometrial cancers in the female and colon cancers are associated with higher body fat.

Clinical and epidemiological studies

Several clinical and epidemiological studies have demonstrated that a change in fat intake could alter the risk of coronary heart disease. (Eckel RH et al 2013) If one needs to reduce the saturated fat intake and instead replaces with isocaloric quantity of carbohydrates, the LDL or bad cholesterol may come down but along with it the good or HDL cholesterol also comes down and the triglyceride levels go up which makes the situation worse.

Considering MUFA as a beneficial fat if we replace the saturated fat with MUFA containing oils, LDL decreases but HDL also comes down thus minimizing the advantage since the ratio of bad to good cholesterol still remains the same.

If we replace Saturated fat with PUFA rich oil, LDL comes down significantly, HDL does not come down much, additionally triglycerides also come down. As mentioned earlier it should be ensured that there should be adequate n3 and the PUFA should not be an exclusively n6 type.

Research has also shown that saturated fat from dairy sources are relatively better than that coming from red meat. Comparing saturated fat intakes from dairy like Butter with saturated fat from veg oil sources, there are no significant differences for cardio vascular disease risks. (Marcia C- de Oliveira Otto et al 2012)

A lower ratio of total cholesterol to HDL cholesterol is even possible with saturated fatty acids like Stearic acid and Lauric acid (Michal and Mozzafarian 2010).

Recent review of evidences shows that lowering dietary cholesterol intakes may not translate into lower blood cholesterol levels but cholesterol intake of about 200-300mg / day may not worsen the blood cholesterol levels. (Dietary Guidelines Advisory Committee USA 2015)

In summary

1. Reducing carbohydrate intakes has much greater benefits of lowering heart disease risks than saturated fats alone
2. PUFA rich oils have significant benefits (Willett WC 2012)
3. There should be a balance of saturated, MUFA, n6 PUFA and n3 PUFA to get the best advantage
4. Quantity of fat consumed should be within the RDA and should be balanced with physical activity
5. Rotation of the oils in our household use with at least 25% of n3 containing oil
6. Eliminate trans fat intake or minimize it to less than 1% of the total energy intake (read food labels)
7. A cholesterol intake within the RDA limit is not a harm. Those with higher blood cholesterol levels may get better benefits through medical treatment.
8. Reducing red meat and increasing fish, tree nuts, soy may provide significant benefits in lowering heart disease risks.
9. Increasing vegetable and fruit intake also indirectly reduce heart disease risks

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(A major part of this article was published by the same author in the FSSAI newsletter for public dissemination and in WCC centenary Symposium in Chennai)

Profile of Author

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Educational Background

Course	Year	College	University
M.B.B.S	1975	Stanley Medical College	Madras University
M.D. Pathology	1983	Gandhi Medical College	Osmania University

Research Career at National Institute of Nutrition

Assistant Research Officer 1977 - 1984; Research Officer 1984 - 1990; Senior Research Officer 1990 - 1995; Assistant Director 1995 - 2000; Deputy Director 2000 - 2006; Officer in-charge, Pathology Division 1989 - 2006; Director April 2006 - Aug. 2012

Current Positions

1. Visiting Faculty Hyderabad Central University, 2. Chairman Review Committee for Genetic Manipulation Govt of India
3. Chairman Scientific Panel on Labeling Food Safety and Standards Authority of India,
4. Member Genetic Engineering Appraisal Committee, 5. Chairman IUNS national committee at the INSA,
6. Vice president, Nutrition Society of India, 7. Vice President- Yakult India Microbiota and Probiotic Science foundation of India

Research Areas

Major : Nutritional Pathology, Toxicology, Sub areas : Diet and Cancer, Nutrition and Cell Death, Publications : 105 (including chapters in 5 books)

Awards / Honours

- Santhinath Ghosh memorial oration. Dept. of chemical technology, Kolkatta University - Nov 2013
- C Ramachandran Memorial Oration, Nutrition Foundation of India - 2012
- Dr. Rajammal Devadas Oration Award Avinashilingam - 2012 University, Coimbatore
- Dr. Florence Theophilus Endowment Lecture, WCC Chennai - 2011
- Dr. S.G. Srikantia Memorial Lecture, Nutrition Society of India, Hyderabad- 2011
- S K Mitra Memorial Award-2009 2010 - All India
- Food Processors' Association at New Delhi
- Kamalapuri Sabharwal Memorial Oration - Lady Irwin - 2009 College, New Delhi
- Dr. P. Narasimha Rao International Award International - 2009 Medical Sciences Academy, New Delhi
- Dr.D. Govinda Reddy Memorial Oration, NTR University - 2008 of Health Sciences, Vijayawada
- Dr.K.V.Rao Memorial Oration, Dr.K.V.Rao Scientific - 2007 Society, Hyderabad.
- RR memorial Oration Dept Oncology, NIMS - 2000.

Life Membership and Fellowships in Scientific Societies

1. Indian Association of Pathologists and Microbiologists, 2. AP Chapter of Pathologists and Microbiologists, 3. Nutrition Society of India, 4. Probiotic Association of India, 5. Fellow - Andhra Pradesh Academy of Sciences, Hyderabad, 6. Fellow - National Academy of Medical Sciences, New Delhi, 7. Fellow of International Academy of Medical sciences

Research Guide : Ph.D., MD and MDS students



Science Spectrum

An Official Journal of Andhra Pradesh Akademi of Sciences

About the "Science Spectrum" Journal

Andhra Pradesh Akademi of Sciences, the first state science Akademi established in the year 1963 has been engaged in the Publication activity as part of its objectives, towards advancement of Science in A.P. Over the years, the Akademi has been publishing journals on science containing Seminar Proceedings, research Articles & review articles. During 2015 the Akademi has initiated the proposal to bring out its official Journal "Science Spectrum" as the official Journal of AP Akademi of Sciences to publish research articles including review

- Physical Sciences
- IT & Computer Sciences
- Chemical Sciences
- Agricultural Sciences
- Earth including Ocean Sciences

articles and short communications. Initially it is proposed to publish four issues (Quarterly) of the Journal per year. The first issue of the Journal "Science Spectrum" is proposed to be released during the AP Science Congress at Tirupati. The following are the details and guidelines for publication of articles in the Journal.

Research Articles: Research Articles are invited from researchers in Academic Institutions, Scientific laboratories and other institutions including industry pertaining to any of the following broad scientific fields including interdisciplinary areas :

- Mathematical Sciences
- Engineering Sciences
- Life Sciences
- Medical and Pharmaceutical Sciences
- Space and Atmospheric Sciences

Short Research Communications: These communications cover the preliminary research findings from the authors own research work. They are fast-tracked for immediate publications

Instructions/ Guidelines to Authors for Manuscript Preparation

Title: It should be bold, 14 point, centered to the page and brief in a maximum of two lines.

Authors: Names should be in bold, 12 point, in the order - family name, middle name and last name. The corresponding author(s) name should be marked with a '*' and provided with his/her email address.

Address: It should be normal, 10 point, with full postal details of department, institute.

Abstract: A short Abstract, 12 point, 10-15 lines (~100-150 words) describing the salient features.

Keywords: A list of 5-6 keywords to be presented below the abstract, in 10 point.

Text: The text, 12 point, should be divided into sub-headings, such as: Introduction, Results and Discussions, Conclusions, Acknowledgements, References.

References Should be provided in parentheses with Author name & year in text of the MS (for example M. Siedlecka et al 2008; Hecht & Huc, 2007) The format of the references to be given in references is as follows:

M. Siedlecka, G. Goch, A. Ejchart, H. Sticht, A. Bierzynski, Proc. Natl. Acad. Sci. USA 1999, 96, 903-908. A. Patgiri, A. L. Jochim, P. S. Arora, Acc. Chem. Res. 2008, 41, 1289-1300.

S. Hecht, I. Huc, (Eds.), Foldamers: Structure, Properties and Applications, Wiley-VCH: Weinheim, Germany, 2007. C. Shellman, In Protein Folding; Jaenicke, R., Ed.; Elsevier: Amsterdam, 1980, pp 53-64.

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- I have taken the consent of all the co-authors before submitting the work, as the corresponding author.
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Reviewers: The authors should provide names of 4 experts/reviewers in respective subjective area, along with the details of address, phone/fax/email for consideration of the Editorial Board. The manuscripts are to be reviewed by two referees and positive assessment from both the referees is essential for final acceptance.

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- **Dietary Fats**
- **Lipid profile of Indians**
- **Recommendations for dietary fat intake in Indians**
- **Clinical Epidemiological Studies**