DOI: JCDR/2012/3967:1933

Original Article

Metabolic Section

Effect of Meat Consumption on the Glycaemic Control, Obesity and Blood Pressure in Patients with Type 2 Diabetes

ASWINI DUTT R., SATISH KUMAR N.S., SHANKAR BHAT K., M. BHIMA BHAT, NEEVAN D.R. D S'OUZA

ABSTRACT

Background: Obesity and Diabetes mellitus have become major public health threats across the globe. A high calorie food consumption and the lack of physical exercise are producing generations that are increasingly obese and diabetic. Diet plays an important role in the causation, management and complications of obesity and type 2 diabetes.

Objectives: To compare meat consumption with the glycaemic control, BMI and blood pressure in patients with type 2 diabetes.

Materials and Methods: This was a retrospective study which was done on the medical records of the patients with type 2 diabetes, who attended the Medicine OPD of a medical college hospital in Mangalore. The study group consisted of 110 male diabetic patients who were on treatment, who were aged between 45 and 65 years. They were divided into two groups, based on their food habits with respect to the type of meat which was consumed (viz. red meat consumers, white meat consumers). Their FBS, PPBS, BMI, blood pressure and diet history were noted. These parameters between the red meat and the white meat consumers were compared by the unpaired t-test.

Results: The results revealed that red meat consumption was positively associated with a poor glycaemic control in terms of both FBS and PPBS ($p < 0.0005$). There was a significant association of the red meat consumption with the BMI and blood pressure ($p < 0.0005$ and $p< 0.004$ respectively).

Conclusion: This study indicated that the consumption of red meat may aggravate the indices of glycaemic control, obesity and blood pressure in patients with type 2 diabetes. A moderation of red meat consumption should be advocated to patients with type 2 diabetes.

Key Words: Red meat, White meat, Type 2 Diabetes, Blood Pressure, BMI, Saturated fat

INTRODUCTION

Globalization has created rapid changes in the urban lifestyles. This has resulted in the emergence of obesity and diabetes mellitus, that are growing realities among people worldwide. These epidemics have created a huge financial burden on the economic growth. There are about 171 million diabetic cases worldwide, of which 31 million persons with diabetes are in India (2000) and this number is predicted to rise to almost 366 million globally and 79.4 million in India by 2030, according to the Diabetes prevalence predictions [1].

A proper dietary management can help in the treatment and prevention of various metabolic disorders such as insulin resistance, obesity, type 2 diabetes mellitus (DM) and the resultant cardiovascular diseases [2].

High intake of red meat like beef and mutton, sweets and oily foods are associated with an increased incidence of DM worldwide [3]. A diet which is rich in vegetables, fruits, whole grains, a limited amount of dairy products, fish and lesser red meat can reduce the incidence of cardio metabolic disorders [4].

Insulin resistance has been associated with the development of the cardio metabolic syndrome [5]. Recent studies have shown that food habits are linked to the risk of insulin resistance, DM and cardiovascular disease [2-5]. Red meat consumption may lead to insulin resistance and hyper-insulinaemia in susceptible persons [6]. Other studies have suggested that that more consumption of fish, seafood and white meat may reduce the risk of DM in populations with a prevalence of obesity [7] and hypertension [8].

As the meat consumption alters their diabetic status, we sought to find out the association of the meat intake and the glycaemic control, Body Mass Index (BMI) and the blood pressure in patients with DM.

MATERIALS AND METHODS

This was a retrospective study which was done from the medical records of the patients with DM, who attended the Medicine Department of a medical college hospital in Mangalore, Karnataka, India, who lived around this coastal area. Ethical clearance was obtained for this project.

The study group consisted of 110 male diabetic patients who were aged between 45 and 65years. They were divided into two groups based on their predominant food habits, with respect to the type of meat which was consumed. (Viz. red meat consumers, white meat consumers). One group consisted of 50 subjects who predominantly consumed red meat for at least 5 days a week. The other group had 60 age matched subjects; exclusively white meat consumers for at least 5 days a week. The cases were chosen randomly for the red meat consuming group. Their diet histories were collected from the dietician's record, that included the amount of food which was consumed everyday for one week for the individual patients. We have plotted the different food items which were consumed along with the meat intake. (grams/week)

Their anthropometric measurements, blood pressure (BP) recordings, fasting blood sugar (FBS) and post prandial blood sugar (PPBS) values and the duration of diabetes and hypertension were noted. The body mass index (BMI) was calculated as weight (in

kilograms) divided by standing height (in meters squared). Those with a BMI which was greater than 24.9 kg/m^2 were defined as overweight and those with a BMI which was greater than 29.9 kg/m^2 were defined as obese. People with systolic/diastolic blood pressure levels of >/= 140/90 mmHg were defined as having hypertension as per the JNC 7 criteria. These parameters between the red meat and the white meat consumers were compared by the unpaired *t*-test.

The statistical software, SPSS, ver17 and MS Excel (2007) was used for the statistical analysis. The data were analyzed for the normal distribution and descriptive statistics were used. All the tests were two-tailed and they were conducted at a 0.05 significance level.

RESULTS

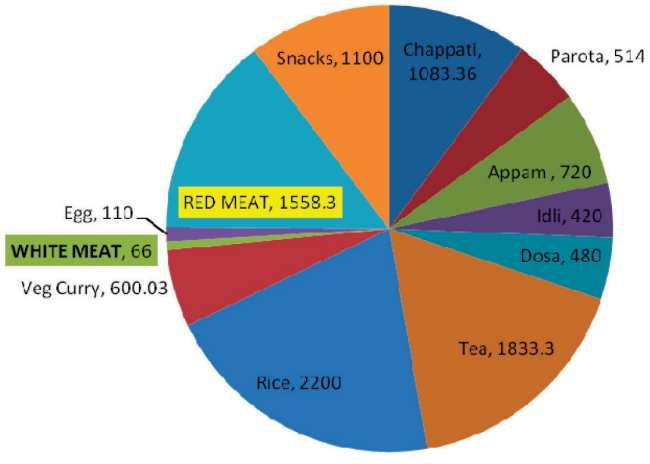
[Table/Fig-1] shows the mean± SD of the age of the patients and of the duration of the diabetes, the mean± SD of the fasting blood sugar (FBS) and of the post-prandial blood sugar (PPBS), of BMI, of the systolic blood pressure (SBP) and of the diastolic blood pressure (DBP) of the two groups.

Parameters	Red meat consumers n =50	White meat consumers n=60	p value
Age in years (Mean± SD)	55.42±5.79	55.05± 6.45	
Duration of Diabetes in years (Mean± SD)	5.28±4.53	7.54±5.30	
FBS (mg/dl)	152.96± 49.32	107.37± 19.64	<0.0005**
PPBS (mg/dl)	237.08± 64.80	159.37± 18.07	0.0005**
SBP (mm Hg)	146.8 ± 19.52	134.0 ± 12.10	0.0005**
DBP (mm Hg)	92.20 ± 8.4	88.07 ± 6.26	0 .004*
BMI (kg/m^2)	26.37 ± 2.39	21.80 ± 3.07	0.0005**

[Table/Fig-1]: Comparison between various parameters of red meat and white meat consumers (Mean± SD)
*p<0.01; **p<0.001.

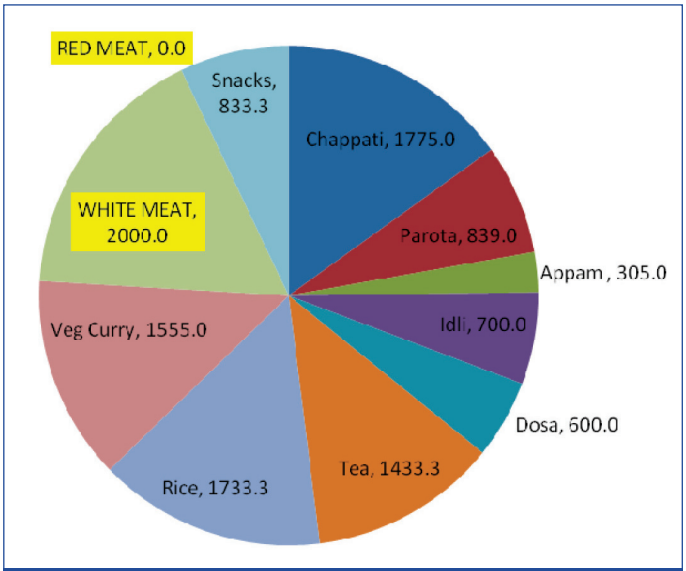
FBS (p<.0005), PPBS (p<.0005), BMI (p<.0005), SBP (p<.0005) and DBP (p=.004) were significantly higher in the red meat diet group in comparison with those in the white meat diet group.

[Table/Fig-2] depicts the average diet pattern of the predominant red meat consumers. In a week, there was a consumption of 1558.3 grams of red meat that included beef and mutton, amidst other regular food items of costal Karnataka. This group also consumed a small amount of white meat (66grams/week).



[Table/Fig-2]: Average diet pattern of predominantly red meat consumers. (Grams/week)

[Table/Fig-3] shows the average diet pattern of the exclusive white meat consumers. This group consumed 2000grams of white meat in the form of fish and chicken exclusively in a week's time.



[Table/Fig-3]: Average diet pattern of exclusively white meat consumers. (Grams/week)

DISCUSSION

This study showed that a relatively higher consumption of red meat may aggravate the indices of the glycaemic control, blood pressure and BMI in Diabetes mellitus.

This coincided with the findings of earlier studies, which revealed that a diet which was rich in red meat increased the blood glucose levels [9]. The saturated fat content of the red meat was the main causative factor for the emergence of insulin resistance in DM [10]. Regular chicken intake (white meat) was associated with a moderately decreased risk of DM, as was shown in Nurses' Health Study [11].The consumption of a diet which contained fish, which was a white meat, could prevent or control the emergence of DM [12].The presence of the omega-3 fatty acids which were present in fish could decrease the occurrence of DM and heart diseases [13].

Insulin resistance which is linked with obesity and cardiovascular abnormality is known as 'the metabolic syndrome'. Over the years, the tissues fail to respond to the increasing insulin levels. Increased levels of triglycerides in the muscle tissue and free fatty acids are seen in the patients of DM [14]. Later, the beta cells of the pancreas get exhausted and they cease production, resulting in clinical DM [15].

Insulin resistance causes glycogenesis and an increased glucose uptake in the muscle cells. The circulating free fatty acid concentration is increased in adipocytes as a result of increased lipolysis [16]. The higher the saturated fatty acid content of the dietary fat which results in higher plasma membrane fatty acid profiles, the more insulin action is impaired [17].

High fat consumption causes obesity and insulin resistance [18]. There exists a clear association between the dietary fats, lipid profiles and the insulin resistance [19]. Fish oil prevented the development of insulin resistance in experimental rats which were earlier fed with safflower oil [20]. Poly unsaturated fatty acids (PUFAs) regulate the insulin sensitive glucose uptake (ISGU) in isolated adipocytes [21]. In animals, an isocaloric, saturated fat diet was found to enhance

the weight more than the unsaturated fats which were present in white meat could enhance it [22]. Similar results were found in humans [23], which were demonstrated by the increasing waistline measurements [24].

The meta-analyses of randomized trials have shown decreased blood pressure levels in hypertensives who consumed fish oil which had PUFAs. An enhanced endothelial vasodilator function, the reduced reactivity of the resistant vessel vascular smooth muscle and an increased vascular compliance could be the underlying causes for the beneficial effect of the PUFAs on blood pressure, as was depicted in animal studies [25-27].

Recent research data has indicated that multiple improvements in the food intake lowered the BP levels of adults, both in pre hypertensives and hypertensives. PUFAs offered more benefits than the known benefits of reduced sodium chloride, increased potassium, prevention of obesity and excess alcohol intake in reducing the BP. This finding was consistent with meta-analytic data of the RCTs. Thus, these results on a major coronary vascular disease risk factor has lent good support to the current recommendations for the increased ingestion of PUFAs from marine and vegetable sources [28].

LIMITATIONS OF THE STUDY

1. Retrospective study
2. Small study group
3. Limited variables
4. Gender limitation.

CONCLUSION

A relatively higher consumption of red meat may lead to hyperglycaemia, hypertension and obesity. The consumption of white meat can lower the complications which arise from DM. It lowers the risk of the development of obesity and hypertension and their complications in DM.

ACKNOWLEDGEMENT

Dr. Moosabba, Professor and Head of the Department of General Surgery, Medical Superintendent, Yenepoya Medical College, Mangalore.

REFERENCES

[1] Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004;27:1047-53.
[2] Steyn NP, Mann J, Bennett PH, Temple N, Zimmet P, Tuomilehto J, et al. Diet, nutrition and the prevention of type 2 diabetes. *Public Health Nutr*. 2004;7:147-65.
[3] Song Y, Manson JE, Buring JE, Liu S. A prospective study of red meat consumption and type 2 diabetes in middle-aged and elderly women: the women's health study. *Diabetes Care*. 2004;27:2108-15.
[4] Kris-Etherton P, Eckel RH, Howard BV. Benefits of a Mediterranean-style and the National Cholesterol Education Program/American Heart Association Step I Dietary Pattern on cardiovascular disease. *Circulation*. 2001;103:1823-25.
[5] Jarrett RJ. The metabolic syndrome. *Lancet*. 2005;366(9501):1922.
[6] Panagiotakos DB, Tzima N, Pitsavos C, Chrysohoou C, Papakonstantinou E, Zampelas A, et al. The relationship between the dietary habits, blood glucose and the insulin levels among people without cardiovascular disease and type 2 diabetes; The ATTICA Study. *Rev Diabet Stud*. 2005;2(4):208-15.
[7] Panagiotakos DB, Pitsavos C, Skoumas Y, Stefanadis C. A study on the association between the food patterns and the metabolic syndrome by using principal components analysis: The ATTICA Study. *J Am Diet Assoc*. 2007;107(6):979-87.
[8] Erkkilä AT, Schwab US, de Mello VD, Lappalainen T, Mussalo H, Lehto S, et al. Effects of fatty and lean fish intake on the blood pressure in subjects with coronary heart disease who used multiple medications. *Eur J Nutr*. 2008;47(6):319-28.
[9] Murakami K, Okubo H, Sasaki S. Effect of dietary factors on the incidence of type 2 diabetes: a systematic review of cohort studies. *J Nutr Sci Vitaminol*. 2005;51:292-310.
[10] Haag M, Dippenaar NG. Dietary fats, fatty acids and insulin resistance: short review of a multifaceted connection. *Med Sci Monit*. 2005;11: 359-67.
[11] Schulze MB, Hoffmann K, Manson JE, Willett WC, Meigs JB, Weikert C, et al. The dietary pattern, inflammation, and the incidence of type 2 diabetes in women. *Am J Clin Nutr*. 2005;82:675-84.
[12] Nettleton JA, Katz R. n-3 long-chain polyunsaturated fatty acids in type 2 diabetes: a review. *J Am Diet Assoc*. 2005;105:428-40.
[13] Holness MJ, Greenwood GK, Smith ND, Sugden MC. Diabetogenic impact of long-chain omega-3 fatty acids on the pancreatic beta-cell function and on the regulation of endogenous glucose production. *Endocrinology*. 2003;144:3958-68.
[14] McGarry JD. Dysregulation of the fatty acid metabolism in the etiology of type 2 diabetes. *Diabetes*. 2002;51:7-18.
[15] Kahn CR. Etiology and pathogenesis of type 2 Diabetes Mellitus and related disorders. In: Principles and Practice of Endocrinology and Metabolism. 3rd Ed. Lippincott, UK; Williams and Wilkins: 2002.
[16] Bergman RN, Ader M. Free fatty acids and the pathogenesis of type 2 diabetes mellitus. *Trends in Endocrinology and Medicine*. 2000; 11:351-56.
[17] Haag M, Dippenaar NG. Dietary fats, fatty acids and insulin resistance: a short review on a multifaceted connection. *Med Sci Monit*. 2005; 11(12):RA359-67.
[18] Storlien LH, James DE, Burleigh KM. Fat feeding causes a widespread insulin resistance, decreased energy expenditure and obesity in rats. *Am J Physiol*. 1986;251:576-83.
[19] Storlien LH, Jenkins AB, Chisholm DJ. Influence of the dietary fat composition on the development of insulin resistance in rats. Relationship to the muscle triglycerides and the w-3 fatty acids in the muscle phospholipids. *Diabetes*. 1991;40:280-89.
[20] Storlien LH, Kraegen EW, Chisholm DJ. Fish oil prevents the insulin resistance which is induced by the high-fat feeding in rats. *Science*. 1987;237:885-88.
[21] Fickova M, Hubert P, Crémel G, Leray C. Dietary (n-3) and (n-6) polyunsaturated fatty acids rapidly modify the fatty acid composition and the insulin effects in rat adipocytes. *J Nutr*. 1998;128:512-19.
[22] Pan DA, Hulbert AJ, Storlien LH. Dietary fats, membrane phospholipids and obesity. *J Nutr*. 1994;124:1555–65.
[23] Van Marken Lichtenbelt WD, Mensink RP, Westerterp KR. The effect of the fat composition of the diet on the energy metabolism. *Zeitschr Ernährungswiss*. 1997;36:303-05.
[24] Doucet E, Alméras N, White MD. Dietary fat composition and human adiposity. *Eur J Clin Nutr*. 1998;52:2-6.
[25] Shimokawa H, Vanhoutte PM. Dietary omega 3 fatty acids and endothelium-dependent relaxations in porcine coronary arteries. *Am J Physiol*. 1989;256:968-73.
[26] Chu ZM, Yin K, Beilin LJ. Fish oil feeding selectively attenuates the contractile responses to noradrenaline and the electrical stimulation in the perfused mesenteric resistance vessels of spontaneously hypertensive rats. *Clin Exp Pharmacol Physiol*. 1992;19:177-81.
[27] McVeigh GE, Brennan GM, Cohn JN, Finkelstein SM, Hayes RJ, Johnson GD. Fish oil improves the arterial compliance in non insulin dependent diabetes mellitus. *Arterioscler Thromb*. 1994;14:1425-29.
[28] Ueshima H, Stamler J, Elliott P, Chan Q, Brown IJ, Carnethon MR, et al. Food omega-3 fatty acid intake of individuals (total, linolenic acid, long-chain) and their blood pressure: INTERMAP study. *Hypertension*. 2007;50(2):313-19.

AUTHOR(S):

1. Dr. Aswini Dutt R.
2. Dr. Satish Kumar N.S.
3. Dr. Shankar Bhat K.
4. Dr. M. Bhima Bhat
5. Dr. Neevan D.R. D S'ouza

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore-575018. Karnataka, India.
2. Assistant Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore-575018. Karnataka, India.
3. Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore-575018. Karnataka, India.
4. Associate Professor, Department of Physiology, Yenepoya Medical College, Deralakatte, Mangalore-575018. Karnataka, India.
5. Lecturer in Biostatistics, Department of Community Medicine, Yenepoya Medical College, Deralakatte, Mangalore-575018. Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Aswini Dutt R.
Assistant Professor, Department of Physiology,
Yenepoya Medical College, Deralakatte,
Mangalore-575018. Karnataka, India.
Phone: +91 9845035530; Fax: +91 8242204667
E-mail: drdutt23@yahoo.com

FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Submission: **Sep 17, 2011**
Date of Peer Review: **Jan 01, 2012**
Date of Acceptance: **Jan 16, 2012**
Date of Publishing: **May 01, 2012**