Association Between Trans Fatty Acids From Natural and Industrial Sources of Diet and Cardiovascular Risk Factors and Endothelial Function of Patients With Type 2 Diabetes Mellitus

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Introduction

In human nutrition, the three main sources of dietary trans fatty acids (TFA) are: transformation of polyunsaturated fatty acids (PUFA) in the rumen of animals; partial hydrogenation of vegetal oils; and during the process of frying foods. Several studies have investigated the difference between the effect of the intake of TFA from ruminant and industrial sources on the risk of cardiovascular disease (CVD). However, these studies often present conflicting results. Considering the importance to minimize the risk of CVD by carefully managing modifiable risk factors in patients with type 2 diabetes mellitus (DM), a better understanding of the different sources of TFA intake and their effects on endothelial function and cardiovascular risk factors is essential.

Objective

To evaluate the relationship between the food products of natural and industrial origin and cardiovascular risk factors, endothelial function and ischemic heart disease (IHC) in patients with type 2 DM.

Methodology

Patients with type 2 diabetes from outpatient clinic

Inclusion criteria
- Non-smokers
- Body mass index < 40 kg/m2
- Triglycerides levels <400 mg/dl
- Normal liver and thyroid function

Exclusion criteria
- Uncontrolled blood pressure
- Cardiovascular event in the preceding 6 months
- Heart failure (class III or IV)
- Presence of renal disease, except diabetic nephropathy
- Use of phosphodiesterase type 5 inhibitors for erectile dysfunction

Clinical Evaluation
- Glycemic control and lipid profile
- Blood pressure control
- Renal function: serum creatinine, urinary albumin
- Cardiovascular evaluation:
  - Coronary heart disease (WHO CV questionnaire, ECG)
  - Peripheral vascular disease (intermittent claudication, absence of posterior tibial pulse)

Nutritional evaluation
- 3-day WDR: one weekend day and two nonconsecutive weekdays
- Nutribase Clinical Nutritional Manager software
- Compliance with the WDR: comparing protein intake (PI) of the WDR to the PI estimated by urinary urea in 24h (ratio PI-WDR to PI-U: 0,79 – 1,26)
- A spreadsheet was constructed to calculate the TFA with data from the Brazilian Table of Food Composition (TACO - Tabela Brasileira de Composição dos Alimentos) and the American table (USDA).

- General clinical and laboratory evaluation
- Training in WDR technique

→ 1-day WDR → (1 week / 4 weeks)

- 3-day WDR + 24-h urine + blood collection (12-h fasting)
- Anthropometric evaluation

→ Ultrasound of the brachial artery

WDR = weighed diet records

Endothelial function assessment

Ultrasound of the Brachial Artery

Endothelial-Dependent Flow-Mediated Vasodilation (FMD): Reactive hyperemia post-ischemia (arterial occlusion with sphygmomanometric cuff inflation) → Record of the longitudinal image of the artery (from 30 s before to 2 min after cuff deflation).

Endothelium-Independent Vasodilation: Reflecting vascular smooth muscle function. Peak vasodilation occurs 3 to 4 min after single dose (0.4 mg) of nitroglycerin spray.

Results

186 patients were analyzed (44% men; mean age: 63 y. and mean BMI: 29.4 kg/m²).

Table 1. Clinical and laboratory characteristics of patients with type 2 diabetes categorized according to the median of Ruminant TFA - VET% (0.33).

	Ingestion < 0.33	Ingestion > 0.33	P
Age	64 ± 9	62 ± 10	0.12
Men	42%	49%	0.45
Duration of DM (years)	17 ± 8	16 ± 9	0.37
Waist circumference	99 ± 10	103 ± 9	0.012
BMI (kg/m2)	28.7 ± 4.3	30.3 ± 4	0.15
Hypertension (%)	81%	83%	0.70
Plasma Glucose (mg/dL)	40%	36%	0.64
A1c (%)	145 ± 54	170 ± 66	<0.01
Total Cholesterol (mg/	8.2 ± 1.8	8.2 ± 1.5	0.89
HDL cholesterol (mg/dL)	180 ± 47	182 ± 40	0.79
LDL cholesterol (mg/dL)	48 ± 13	46 ± 11	0.24
Non-HDL cholesterol	103 ± 41	102 ± 34	0.78
Triglycerides (mg/dL)	131 ± 54	139 ± 39	0.48

It was observed that the intake of TFA of ruminants was associated with the WC of higher CV risk (dependent variable) [Risk Ratio: 2.45 (95% CI: 1.11 – 5.38); P=0.026], adjusted for sex and age.

Table 2. Analysis of endothelial function of patients with type 2 diabetes divided according to trans-r.

	Lower trans-r intake	Higher trans-r intake	P
FMD (%)	5,74 (-1,6 - 16,9)	4.9 (-2.6 - 20,1)	0,606
Proportion with lower FMD (%) *	48,9	52,2	0,38
Diameter of the brachial artery (mm)	0,34 (0,22 - 0,53)	0,36 (0,18 - 0,53)	0,108
Proportion with larger diameter (%) **	45,6	57,8	0,068

Data are expressed as median (minimum-maximum) or patients with the characteristic (%) flow-mediated dilatation (FMD) . * It is defined as lower FMD when below the median in the whole group. ** It is defined as greater diameter when above the median of the whole group.

Also, the intake of TFA of ruminants was associated with the greater diameter of the brachial artery [Risk Ratio: 1.93 (95% CI: 1.01 – 3.69); P=0.047], adjusted for age, presence of hypertension and WC.

No association was found between the TFA from industrial sources and the CV risk factors and parameters of endothelial function.

When dietary characteristics of patients with and without IC were compared, no significant differences were observed between energy intakes, macronutrients, as well as the intake of trans-FA and its fractions.

Conclusion

The present study suggests that the greater consumption of TFA from ruminant sources in patients with type 2 DM is related to the greater abdominal circumference and worse endothelial function.

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