·临床研究·

2型糖尿病患者视网膜神经纤维层厚度与膳食脂肪的相关性

刘杰,张慧娟*,徐佳佳
(哈尔滨医科大学附属第一医院内分泌科, 哈尔滨 150001)

【摘 要】 **目的** 探讨2型糖尿病(T2DM)患者视网膜神经纤维层(RNFL)厚度与膳食脂肪的相关性。**方法** 选取就诊于哈尔滨医科大学附属第一医院内分泌科的186例T2DM患者。收集入组患者的一般临床资料,包括年龄、性别、病程、既往史、吸烟饮酒史、入院血压、身高、体质量等,并计算体质量指数(BMI)等指标。记录糖化血红蛋白A1c、空腹C肽、血脂、肾功能等相关血化验结果,光学相干断层成像(OCT)测量RNFL厚度。入组人员填写半定量饮食频率问卷。采用SPSS 22.0软件进行统计学分析,Spearman秩相关分析各象限RNFL厚度与膳食脂肪量之间的相关关系;采用单元和多元线性回归分析双眼各象限RNFL厚度的独立影响因素。**结果** (1)相关分析显示,畜禽肉及肉制品与视网膜上、下方RNFL厚度(上方:$r=-0.192$, $P=0.009$;下方:$r=-0.286$, $P=0.000$)显著负相关;软饮与眼睛上方及下方RNFL厚度(上方:$r=-0.169$, $P=0.021$;下方:$r=-0.264$, $P=0.000$)均显著负相关;血清甘油三酯与视网膜下方、鼻侧RNFL厚度(下方:$r=-0.210$, $P=0.004$;鼻侧:$r=-0.150$, $P=0.041$)均显著负相关;血清肌酐与视网膜上方及鼻侧RNFL厚度(上方:$r=-0.159$, $P=0.032$;鼻侧:$r=-0.156$, $P=0.036$)呈负相关;年龄也与眼睛上方及鼻侧RNFL厚度(上方:$r=-0.169$, $P=0.021$;鼻侧:$r=-0.184$, $P=0.012$)呈负相关关系。(2)单元线性回归分析表明,年龄、甘油三酯、血肌酐、畜禽肉及肉制品与T2DM患者RNFL厚度相关($P<0.05$)。在上述单元线性回归分析基础上,以T2DM患者各象限RNFL为因变量,以年龄、甘油三酯、血肌酐、禽畜肉及肉制品为自变量,行多元线性回归分析,结果显示甘油三酯($P=0.007$)、禽畜肉及肉制品($P=0.021$)是视网膜下方象限RNFL厚度的独立影响因素。年龄($P=0.013$)、甘油三酯($P=0.044$)为视网膜鼻侧象限RNFL厚度的独立影响因素。血肌酐($P=0.042$)是眼睛颞侧象限RNFL厚度的独立影响因素。**结论** 畜禽肉及肉制品的摄入量与T2DM患者RNFL厚度密切相关,饮食干预对预防T2DM视网膜病变有一定临床意义。

【关键词】 视网膜神经纤维;膳食脂肪;视网膜神经退行性变
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Correlation between thickness of retinal nerve fiber layer and dietary fat in type 2 diabetes mellitus

LIU Jie, ZHANG Hui-Juan*, XU Jia-Jia
(Department of Endocrinology, First Hospital Affiliated to Harbin Medical University, Harbin 150001, China)

【**Abstract**】 **Objective** To investigate the correlation between the thickness of retinal nerve fiber layer (RNFL) and dietary fat in patients with type 2 diabetes mellitus (T2DM). **Methods** A total of 186 in-patients with T2DM admitted to our department were selected for the study. Their general clinical data were retrieved, including age, gender, disease course, previous history, smoking and drinking history, admission blood pressure, height, and body mass, and body mass index (BMI) was calculated. Blood test results such as glycosylated hemoglobin A1c, fasting C-peptide, blood lipid and kidney function were recorded, and RNFL thickness was measured by optical coherence tomography. A semi-quantitative dietary frequency questionnaire was conducted with each participant. SPSS statistics 22.0 was used for statistical analysis, and Spearman rank correlation analysis for correlation between RNFL thickness and dietary fat mass. The univariate and multivariate linear regression analysis were performed to explore the independent influencing factors of RNFL thickness in each quadrant of both eyes. **Results** (1) Livestock and poultry meat and meat products were significantly negatively correlated with the superior and inferior RNFL thickness (superior: $r=-0.192$, $P=0.009$; inferior: $r=-0.286$, $P=0.000$). Soft drinks were significantly negatively correlated with the superior and inferior RNFL thickness (superior: $r=-0.169$, $P=0.021$; inferior: $r=-0.264$, $P=0.000$). There was a significant negative correlation between serum triglycerides (TG) and the

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通信作者: 张慧娟, E-mail: hydzhj@126.com

inferior, nasal RNFL thickness (inferior: $r=-0.210$, $P=0.004$; nasal: $r=-0.150$, $P=0.041$). Serum creatinine (SCr) was negatively correlated with the superior and nasal RNFL thickness (superior: $r=-0.159$, $P=0.032$; nasal: $r=-0.156$, $P=0.036$). Age was also negatively correlated with the superior, nasal RNFL thickness (superior: $r=-0.169$, $P=0.021$; nasal: $r=-0.184$, $P=0.012$). (2) Univariate linear regression analysis showed that age, TG, SCr, poultry meat and meat products were associated with RNFL in patients with T2DM ($P<0.05$). On the basis of the above univariate linear regression, multivariate linear regression was performed with RNFL thickness in each quadrant of T2DM patients as the dependent variable and age, TG, SCr, poultry meat and meat products as the independent variables, which showed that TG ($P=0.007$), poultry meat, and meat products ($P=0.021$) as independent influencing factors for the inferior RNFL thickness; age ($P=0.013$) and TG ($P=0.044$) for RNFL thickness in the nasal quadrant; and SCr ($P=0.042$) for the RNFL thickness in the temporal quadrant of the eye. **Conclusion** The intake of livestock and poultry meat and meat products is closely related to the thickness of RNFL in the patients with T2DM, and dietary intervention has clinical significance for early prevention of T2DM retinopathy.

【Key words】 retinal nerve fiber layer; dietary fat; retinal neurodegeneration

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Corresponding author: ZHANG Hui-Juan, E-mail: hydzhj@126.com

糖尿病视网膜病变(diabetic retinopathy,DR)是 2 型糖尿病(type 2 diabetes mellitus,T2DM)常见慢性微血管并发症,其对视力有损害,严重者可导致失明。最新研究表明,糖尿病(diabetes mellitus,DM)患者在出现临床可见的视网膜微血管改变前,早已有视网膜神经退行性改变[1,2]。视网膜神经纤维层(retinal nerve fiber layer,RNFL)厚度可作为监测视网膜神经退行性变的早期指标,可通过光学相干断层成像(optical coherence tomography,OCT)对 RNFL 厚度进行精确测量以观察其变化。医学营养治疗是 DM 基础管理措施。当代高脂饮食结构和久坐少运动的生活方式增加了 DM 发病率,而自我管理不善、血糖控制不佳的 T2DM 患者则更易发展为 DR。本研究拟通过 OCT 测量视盘周围 RNFL 厚度,探索 T2DM 患者 RNFL 与膳食脂肪的相关性。

1 对象与方法

1.1 研究对象

选取就诊于哈尔滨医科大学附属第一医院内分泌科的 186 例 T2DM 患者,其中男性 122 例,女性 64 例,年龄 17~80(53.13±11.42)岁,糖尿病病程 0~42(9.14±8.21)年。纳入标准:(1)符合 WHO 1999 年制订的《糖尿病诊断标准》;(2)既往无高眼压病史,眼压范围 11~21 mmHg(1 mmHg=0.133 kPa),双眼眼压差<5 mmHg;(3)无特殊眼部病史。

1.2 研究方法

收集入组患者的一般临床资料,包括年龄、性别、病程、既往史、吸烟饮酒史、入院血压、身高、体质量,计算体质量指数(body mass index,BMI)。所有研究对象均进行眼科常规检查,包括视功能、眼压、眼底镜。

血生化检查:研究对象均禁食 12 h 后清晨抽取肘静脉血约 5 ml。检测糖化血红蛋白 A1c(glycosylated hemoglobin A1c,HbA1c)、总胆固醇(total cholesterol,TC)、甘油三酯(triglycerides,TG)、高密度脂蛋白胆固醇(high density lipoprotein cholesterol,HDL-C)、低密度脂蛋白胆固醇(low density lipoprotein cholesterol,LDL-C)、血肌酐(serum creatinine,SCr)、尿素氮(blood urea nitrogen,BUN)、尿微量白蛋白(microalbunminuria,mALB)、空腹 C 肽。

半定量食物频率问卷(semi-quantitative food frequency questionnaire,SQFFQ):由专业人员问询入组人员半定量饮食频率问卷。根据食物的摄入频率及脂肪含量制定食物频率问卷,共包括 3 大类(主食、动物性食物、软性饮品及其他食物)12 种条目(油炸面食、猪牛羊等畜肉、鸡鸭鹅等禽肉、肉制品、水产/海鲜品、蛋类、坚果、巧克力、糕点、奶制品、软饮、酒精),分别询问调查对象过去 1 周里每种(类)食物的摄入频率和平均每次摄入量,同时按家庭成员的标准人系数比例对家庭消费的烹调油分配,得到每个调查对象烹调油的摄入量。

OCT 测定 RNFL 层厚度:应用德国海德堡 OCT 仪(870 nm 波长,40 000 Hz/s)进行检查,在光线相对柔和的检查室内,受检者坐在设备前,下颌置于下颌托上,调整机器高度,调整受检者头位到正直,选择“Fast RNFL Thickness”扫描模式,进行以视盘中点为中心,对视盘做直径为 3.45 mm 圆周的环形扫描,行 3 次重复性较好的优化扫描,利用计算机图像分析系统进行 RNFL 厚度的测量,测量参数包括:上方(S)、下方(I)、鼻侧(N)、颞侧(T)RNFL 厚度,取 3 次测量平均值为该受试眼的 RNFL 厚度。对视盘周围视网膜神经纤维层厚度测量,同一操作者使用

同一设备,每眼至少扫描3次,取信号最好、重复率最高的数值进行保存分析。

1.3 统计学处理

采用SPSS 22.0软件进行统计学分析,Spearman秩相关分析各象限RNFL厚度与膳食脂肪量之间的相关关系;采用单元和多元线性回归分析双眼各象限RNFL厚度的独立影响因素。$P<0.05$为差异有统计学意义。

2 结 果

2.1 各象限RNFL厚度与相关指标的相关性分析

眼睛上方、下方、鼻侧、颞侧4个象限RNFL厚度与相关指标的Spearman秩相关分析结果见表1。畜禽肉及肉制品摄入量与视网膜上、下方RNFL厚度(上方:$r=-0.192$,$P=0.009$;下方:$r=-0.286$,$P=0.000$)显著负相关;软饮与眼睛上方及下方RNFL厚度(上方:$r=-0.169$,$P=0.021$;下方:$r=-0.264$,$P=0.000$)均显著负相关;血清TG与视网膜下方、鼻侧RNFL厚度(下方:$r=-0.210$,$P=0.004$;鼻侧:$r=-0.150$,$P=0.041$)均显著负相关;SCr与视网膜上方及鼻侧RNFL厚度(上方:$r=-0.159$,$P=0.032$;鼻侧:$r=-0.156$,$P=0.036$)呈负相关;年龄也与眼睛上方及鼻侧RNFL厚度呈负相关关系(上方:$r=-0.169$,$P=0.021$;鼻侧:$r=-0.184$,$P=0.012$)。

2.2 单元线性回归分析结果

以T2DM患者各象限RNFL为因变量,进行单因素线性回归分析,结果显示:年龄、TG、SCr、畜禽肉及肉制品与T2DM患者RNFL厚度相关($P<0.05$)。详见表2,3。

2.3 多元线性回归分析

在上述单元线性回归分析基础上,以T2DM患者各象限RNFL为因变量,以年龄、TG、SCr、禽畜肉及肉制品为自变量,行多元线性回归分析,结果显示TG、禽畜肉及肉制品是视网膜下方象限RNFL厚度的独立影响因素。年龄、TG为视网膜鼻侧象限RNFL厚度的独立影响因素。SCr是眼睛颞侧象限RNFL厚度的独立影响因素。详见表4~6。

表1 各象限RNFL厚度与相关指标相关性分析

Table 1 Correlation analysis between RNFL thickness and relevant indicators in each quadrant ($n=186$)

Item	Superior		Inferior		Nasal		Temporal	
	r	P value	r	P value	r	P value	r	P value
Age	−0.169	0.021*	0.056	0.450	−0.184	0.012*	−0.048	0.514
DM duration	−0.018	0.810	0.134	0.067	−0.058	0.430	−0.062	0.397
BMI	0.013	0.856	−0.029	0.695	−0.038	0.612	−0.051	0.488
SBP	0.028	0.703	0.033	0.650	−0.035	0.638	−0.013	0.862
DBP	0.006	0.930	−0.003	0.972	−0.054	0.461	−0.015	0.843
Smoking	−0.057	0.441	−0.115	0.118	−0.072	0.328	−0.116	0.116
Drinking history	0.051	0.490	−0.045	0.540	−0.024	0.749	−0.001	0.994
HbA1c	−0.028	0.705	−0.042	0.571	0.008	0.917	−0.019	0.800
Fasting c-peptide	0.010	0.892	−0.047	0.533	−0.028	0.711	0.006	0.935
TC	0.009	0.902	0.038	0.602	−0.034	0.644	0.060	0.415
TG	−0.110	0.134	−0.210	0.004*	−0.150	0.041*	−0.093	0.205
HDL-C	−0.017	0.820	0.036	0.629	−0.069	0.347	0.026	0.724
LDL-C	−0.032	0.668	0.072	0.331	−0.020	0.790	0.008	0.914
BUN	−0.101	0.177	−0.056	0.458	−0.124	0.096	0.040	0.591
SCr	−0.159	0.032*	−0.117	0.117	−0.156	0.036*	−0.110	0.142
mALB	0.023	0.758	−0.037	0.621	0.005	0.947	−0.055	0.461
Right intraocular pressure	0.115	0.119	−0.021	0.775	0.090	0.220	0.095	0.196
Left intraocular pressure	0.069	0.352	−0.038	0.611	−0.059	0.428	0.086	0.242
Fried staple foods	0.058	0.430	0.100	0.175	0.011	0.884	0.110	0.134
Pastries	0.044	0.549	−0.008	0.919	0.078	0.294	0.050	0.501
Livestock and poultry meat and meat products	−0.192	0.009*	−0.286	0.000*	−0.142	0.052	−0.014	0.853
Fish and shrimp	0.024	0.745	0.085	0.249	−0.009	0.907	−0.067	0.362
Dairy and dairy products	−0.135	0.065	−0.011	0.883	−0.048	0.513	−0.104	0.159
Nuts	−0.064	0.384	−0.017	0.813	−0.090	0.222	−0.101	0.172
Soft drinks	−0.169	0.021*	−0.264	0.000*	−0.075	0.311	−0.067	0.367
Alcohol consumption	0.097	0.188	0.032	0.662	0.046	0.535	0.002	0.978
Edible oil	−0.069	0.350	−0.013	0.865	−0.040	0.589	0.056	0.448

RNFL: retinal nerve fiber layer; DM: diabetes mellitus; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; HbA1c: glycosylated hemoglobin A1c; TC: total cholesterol; TG: triglycerides; HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; mALB: microalbunminuria; BUN: blood urea nitrogen; SCr: serum creatinine. *$P<0.05$.

表 2 T2DM 患者视网膜上方和下方象限 RNFL 厚度单元线性回归分析结果

Table 2 Univariate linear regression analysis of the superior and inferior RNFL thickness in patients with T2DM

Item	Superior			Inferior		
	b	*t*	*P* value	*b*	*t*	*P* value
Age	−0.156	−2.142	0.034*	0.058	0.783	0.434
DM duration	−0.050	−0.608	0.497	0.109	1.491	0.138
BMI	−0.017	−0.230	0.819	−0.051	−0.695	0.488
SBP	−0.080	−1.092	0.276	−0.010	−0.129	0.898
DBP	−0.061	−0.826	0.410	−0.022	−0.293	0.770
Smoking	−0.095	−1.289	0.199	−0.062	−0.844	0.400
Drinking history	−0.006	−0.086	0.932	−0.074	−1.001	0.318
HbA1c	−1.318	−1.318	−1.318	−0.008	−0.107	0.915
Fasting c-peptide	−0.018	−0.243	0.808	−0.020	−0.265	0.791
TC	0.013	0.182	0.855	0.026	0.354	0.723
TG	−0.134	−1.841	0.067	−0.215	−2.980	0.003*
HDL-C	−0.015	−0.208	0.836	0.058	0.785	0.433
LDL-C	0.047	0.638	0.525	0.118	1.616	0.108
BUN	−0.105	−1.407	0.161	−0.025	−0.340	0.734
SCr	−0.125	−1.685	0.094	0.002	0.031	0.975
mALB	−0.094	−1.259	0.210	−0.076	−1.026	0.306
Right intraocular pressure	0.086	1.169	0.244	−0.027	−0.361	0.718
Left intraocular pressure	0.031	0.419	0.676	−0.046	−0.625	0.533
Fried staple foods	0.024	0.331	0.741	0.086	1.166	0.245
Pastries	−0.060	−0.808	0.420	−0.053	−0.723	0.471
Livestock and poultry meat and meat products	−0.180	−2.480	0.014*	−0.236	−3.297	0.001*
Fish and shrimp	0.017	0.235	0.814	0.000	0.004	0.997
Dairy and dairy products	−0.135	−1.854	0.065	−0.011	−0.147	0.883
Nuts	−0.084	−1.148	0.252	−0.124	−1.697	0.091
Soft drinks	−0.064	−0.871	0.385	−0.136	−1.867	0.063
Alcohol consumption	−0.010	−0.137	0.891	−0.075	−1.021	0.309
Edible oil	−0.038	−0.517	0.606	−0.042	−0.571	0.569

T2DM: type 2 diabetes mellitus; RNFL: retinal nerve fiber layer; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; HbA1c: glycosylated hemoglobin A1c; TC: total cholesterol; TG: triglycerides; HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; mALB: microalbunminuria; BUN: blood urea nitrogen; SCr: serum creatinine. * $P<0.05$.

3 讨 论

研究发现,许多无青光眼和其他眼部疾病的 DM 患者常发生 RNFL 变薄[3],关于 T2DM 患者中 RNFL 厚度相关的影响因素并未得到一致结论。流行病学研究中膳食脂肪与 T2DM 之间的关联并不一致,且膳食脂肪对 T2DM 及 DR 的影响仍有待研究。本研究首次探讨 T2DM 患者中 RNFL 与膳食脂肪的相关性。

研究发现[4],DM 患者 RNFL 的损失与多种因素相关,如氧化应激、晚期糖基化终产物(advanced glycation endproducts,AGEs)和阻碍视网膜神经节细胞轴突逆向流动等。据报道[5],膳食脂肪可作为 AGEs 外源性来源影响视网膜病变的发展,AGEs 在牛肉和奶酪等乳制品中含量最高,其次是家禽、猪肉、鱼和蛋。食物的制备方法也对 AGEs 含量有影响,高温或明火等烹饪方法会增加 AGEs 的生成[6],增加 T2DM 患病风险[7]。Amano 等[8]发现 AGEs 在视神经筛状板及视神经血管周围积累还可能导致糖尿病患者视神经病变的发生。AGEs 对 DR 的发生、发展也有影响:AGEs 与视网膜毛细血管周细胞的丢失有关,导致炎症、氧化应激及血管内皮生长因子(vascular endothelial growth factor,VEGF)的激活[9]。VEGF 是 DR 发展过程中重要的参与者之一,是新生血管的关键驱动因素,而新生血管是增殖性糖尿病视网膜病变(proliferative diabetic retinopathy,PDR)的重要标志[10]。基于以上可能机制推测畜禽肉及肉制品 AGEs 含量高,通过 AGEs 影响 T2DM 患者 RNFL 厚度变化。本研究发现,在 T2DM 患者中,畜禽肉及肉制品的摄入量是视网膜 RNFL 厚度的影响因素,大量摄入畜禽肉及肉制品会使 RNFL 厚度变薄。

表3 T2DM患者眼部鼻侧、颞侧象限RNFL厚度单元线性回归分析结果

Table 3 Univariate linear regression analysis of the nasal and temporal RNFL thickness in patients with T2DM

Item	Nasal			Temporal		
	b	*t*	*P* value	*b*	*t*	*P* value
Age	−0.162	−2.233	0.027*	−0.088	−1.192	0.235
DM duration	−0.096	−1.306	0.193	−0.047	−0.633	0.528
BMI	−0.031	−0.413	0.680	−0.086	−1.162	0.247
SBP	−0.110	−1.508	0.133	−0.075	−1.027	0.306
DBP	−0.073	−0.996	0.320	−0.032	−0.436	0.663
Smoking	−0.098	−1.332	0.184	−0.099	−1.347	0.180
Drinking history	−0.055	−0.747	0.456	−0.068	−0.924	0.357
HbA1c	−0.037	−0.491	0.624	0.054	0.723	0.471
Fasting C-peptide	−0.042	−0.555	0.580	−0.055	−0.730	0.466
TC	0.025	0.346	0.730	−0.002	−0.022	0.983
TG	−0.117	−1.598	0.112	−0.018	−0.241	0.810
HDL-C	−0.053	−0.715	0.476	−0.018	−0.241	0.810
LDL-C	0.084	1.144	0.254	0.107	1.454	0.148
BUN	−0.104	−1.393	0.165	−0.017	−0.233	0.816
SCr	−0.046	−0.622	0.535	−0.151	−2.043	0.042*
mALB	−0.026	−0.342	0.732	−0.034	−0.449	0.654
Right intraocular pressure	−0.007	−0.090	0.928	0.091	1.243	0.215
Left intraocular pressure	−0.095	−1.301	0.195	0.049	0.669	0.504
Fried staple foods	0.080	1.088	0.278	0.064	0.875	0.383
Pastries	0.047	0.641	0.523	0.045	0.616	0.539
Livestock and poultry meat and meat products	0.002	0.029	0.977	−0.043	−0.588	0.557
Fish and shrimp	−0.061	−0.825	0.410	−0.086	−1.172	0.243
Dairy and dairy products	−0.048	−0.655	0.513	−0.104	−1.413	0.159
Nuts	−0.046	−0.619	0.536	−0.044	−0.602	0.548
Soft drinks	−0.045	−0.611	0.542	0.076	1.040	0.300
Alcohol consumption	0.023	0.307	0.759	−0.058	−0.783	0.435
Edible oil	0.020	0.265	0.791	0.041	0.556	0.579

T2DM: type 2 diabetes mellitus; RNFL: retinal nerve fiber layer; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; HbA1c: glycosylated hemoglobin A1c; TC: total cholesterol; TG: triglycerides; HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; mALB: microalbunminuria; BUN: blood urea nitrogen; SCr: serum creatinine. *$P<0.05$.

表4 T2DM患者下方象限RNFL厚度多元线性回归分析

Table 4 Multivariate linear regression analysis of the inferior RNFL thickness in patients with T2DM

Item	*b*	*SE*	*b′*	*t*	*P* value
Intercept	158.138	9.574		16.517	0.000
TG	−0.404	0.160	−0.185	−2.519	0.013
Livestock and poultry meat and meat products	−2.533	1.251	−0.149	−2.025	0.044

T2DM: type 2 diabetes mellitus; RNFL: retinal nerve fiber layer; TG: triglycerides.

表5 T2DM患者眼部鼻侧象限RNFL厚度多元线性回归分析结果

Table 5 Multivariate linear regression analysis of the nasal RNFL thickness in patients with T2DM

Item	*b*	*SE*	*b′*	*t*	*P* value
Intercept	84.507	3.408		24.795	0.000
Age	−2.529	0.932	−0.196	−2.712	0.007
TG	−0.007	0.003	−0.169	−2.335	0.021

T2DM: type 2 diabetes mellitus; RNFL: retinal nerve fiber layer; TG: triglycerides.

表6 T2DM患者眼部颞侧象限RNFL厚度多元线性回归分析结果

Table 6 Multivariate linear regression analysis of the temporal RNFL thickness in patients with T2DM

Item	*b*	*SE*	*b′*	*t*	*P* value
Intercept	85.261	3.543		24.063	0.000
SCr	−0.106	0.052	−0.151	−2.043	0.042

T2DM: type 2 diabetes mellitus; RNFL: retinal nerve fiber layer; SCr: serum creatinine.

本研究还探讨了软饮料与患者 RNFL 厚度的关系。在相关分析中二者存在显著相关性,软饮料与患者上方、下方视网膜 RNFL 厚度呈负相关。此外,本研究还发现年龄是 T2DM 患者 RNFL 厚度的影响因素,年龄与患者鼻侧 RNFL 厚度呈显著负相关。Peng 等[11]发现,年龄超过 41 岁的参与者中,随着年龄的增加,患者的 RNFL 厚度显著变薄。众多研究发现,随着年龄增长,OCT 观测到的 RNFL 厚度会明显变薄。年龄每增加 10 年,视网膜 RNFL 厚度约减少 2.6~2.9 μm[12]。相关研究显示视神经纤维随年龄增加而丢失,每年大约丢失 4 000~5 000 个视神经纤维[13,14]。最近的形态学研究发现,年龄相关的 RNFL 厚度减少主要是由于神经元和视神经胶质减少所致[15]。

本研究存在一定的局限性。(1)样本量不足,且入组人群均为 T2DM,对单一人群进行饮食调查,饮食种类难免会有偏差;(2)由于条件所限,对入组的 T2DM 患者未按照视网膜病变程度分组,未能进一步了解 T2DM 视网膜病变各阶段 RNFL 与膳食脂肪的关系;(3)半定量膳食频率问卷中未对各类食物类别进一步细分,且询问饮食问卷主观性大,问卷结果可能与受访者的真实情况有出入。

综上所述,饮食是 T2DM 管理的重要方面,尤其是膳食脂肪摄入量在 T2DM 视网膜病变的发展中发挥着作用。膳食脂肪的许多方面尚未被了解,仍迫切需要进一步临床研究。日常生活中减少畜禽肉及肉制品的摄入量对预防 T2DM 视网膜病变有一定临床意义,可为 T2DM 患者提供可行的饮食干预途径。

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