

应用营养

超重肥胖儿童非酒精性脂肪肝与内脏脂肪指数的相关性研究

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摘要:目的 对鹤壁市超重肥胖儿童非酒精性脂肪肝(NAFLD)与内脏脂肪指数(VAI)情况及相关性进行分析, 以期为早期预防肥胖超重儿童发生NAFLD提供理论参考。方法 择2020年5月至2021年5月于鹤壁市疾病预防控制中心体检的1013例一年级儿童, 筛选出肥胖超重儿童243例, 依据其NAFLD患病情况分为非NAFLD组和NAFLD组, 对比两组患儿基础临床资料、VAI、血脂相关指标及胰岛素抵抗指数(HOMA-IR), 以二元Logistic回归分析单因素显著差异的因子与NAFLD间的相关性。结果 本研究从243例肥胖超重儿童中筛查出46例NAFLD患儿, 占比18.93%。NAFLD组患儿女童数、VAI、腰围、BMI、HOMA-IR及TG均显著高于非NAFLD组, 男童数、HDL-C显著低于非NAFLD组($P<0.05$)。两组TC、年龄及LDL-C无显著差异($P>0.05$)。Spearman秩相关分析知, 肥胖超重儿童HDL-C与NAFLD间呈显著负相关($P<0.01$), TG($P<0.01$)、HOMA-IR($P<0.01$)和VAI($P<0.05$)与NAFLD间呈显著正相关。排除混杂因素后经二元Logistic回归分析可知, 肥胖超重儿童性别、VAI及HOMA-IR均与NAFLD有密切关系, 其中, 男童、VAI、HOMA-IR水平上升均可使患儿患NAFLD概率显著增加($P<0.05$)。结论 鹤壁市超重肥胖儿童发生NAFLD与其VAI水平密切正相关, VAI上升可使其患NAFLD风险显著提升, 临床可依据其VAI进行该病的预防与干预。

关键词: 超重肥胖儿童; 非酒精性脂肪肝; 内脏脂肪指数; 相关性分析

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Correlation analysis between nonalcoholic fatty liver disease and visceral adiposity index of overweight and obese children

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Abstract: Objective To provide a theoretical reference for early prevention of nonalcoholic fatty liver disease (NAFLD) in obese and overweight children, the situation and correlation of NAFLD and visceral adiposity index (VAI) of overweight and obese children in Hebi city were analyzed. **Methods** A total of 243 obese and overweight children were screened from 1013 first-grade children who accepted physical examination at Center for Disease Control and Prevention in Hebi City from May 2020 to May 2021. They were divided into non-NAFLD group and NAFLD group. The basic clinical data, VAI, related blood lipid indexes, and insulin resistance index (HOMA-IR) between the two groups were compared. The correlation between single factors with significant differences and NAFLD were analyzed by binary logistic regression. **Results** Forty-six children with NAFLD were screened from 243 obese and overweight children, accounting for 18.93%. The number of girls, VAI, waist circumference, BMI, HOMA-IR and TG in the NAFLD group were higher than the non-NAFLD group significantly ($P<0.05$). The number of boys and HDL-C in the NAFLD group were lower than the non-NAFLD group significantly ($P<0.05$). There was no significant difference in TC, age and LDL-C between the two groups ($P>0.05$). Spearman rank correlation analysis showed that there was a significant negative correlation between HDL-C and NAFLD in obese and overweight children ($P<0.05$). TG, HOMA-IR and VAI were significantly positive correlated with NAFLD ($P<0.05$). After excluding the confounding factors, binary logistic regression analysis showed that gender,

VAI and HOMA-IR in obese and overweight children were significantly related to NAFLD. Among them, larger numbers of boys and increased levels of VAI and HOMA-IR could increase the probability of NAFLD significantly ($P < 0.05$).

Conclusion The occurrence of NAFLD in overweight and obese children in Hebi city is closely and positively related to VAI level. Higher VAI level can significantly increase the risk of NAFLD. Clinical prevention and intervention could be conducted according to their VAI level.

Key words: Overweight and obese children; non-alcoholic fatty liver disease; visceral adiposity index; correlation analysis

非酒精性脂肪肝(Non-alcoholic fatty liver disease, NAFLD)为一类肝实质细胞发生脂肪贮集和脂肪变性等病理特征性变化,但患者不饮酒或无过量饮酒史的临床综合征^[1]。有研究显示^[2],NAFLD在学龄儿童中患病率可达10%,其中在肥胖儿童中患病率可高达44%~70%,患者初期往往症状轻微,极易被患者忽略,但若未在此阶段进行及时、有效地干预,极易进展为脂肪性肝炎,并在10年病程内发展为肝硬化,甚至有15%以上患者最终发展为肝癌,故对具有较高发病风险的肥胖超重儿童NAFLD患病情况进行调研,并分析NAFLD发生的相关危险因素,找出对早期NAFLD分层筛查有效的指标,对学龄儿童该病的预防、及时发现及预后改善具有重大意义^[3]。有学者研究发现^[4-5],NAFLD的出现和发展基础为代谢异常以及脂肪累积变性等病理变化、血清脂质相关指标、体质量指数(Body mass index, BMI)以及腰围(Waist circumference, WC)等与成人NAFLD的发生有密切相关性,而高尿酸血症、长期肥胖过度等则与儿童两种脂肪肝疾病(Both fatty liver diseases, BAFLD)发生密切有关,但不论是WC、血清脂质因子、BMI还是肥胖单独对NAFLD的分层诊断价值均较差。内脏脂肪指数(Visceral adiposity index, VAI)是依据三酰甘油(Triacylglycerol, TG)、BMI、WC及高密度脂蛋白胆固醇(High density lipoprotein cholesterol, HDL-C)四项水平经计算而得的,可对代谢和表型综合情况的指标,多应用于心脏代谢风险评估^[6]。有学者经研究后发现成年NAFLD与VAI间有一定联系,但关于其与儿童NAFLD间的关系以及是否对NAFLD早期的分层诊断有参考价值研究鲜少^[7],故本研究选取河南省鹤壁市2020年5月至2021年5月间一年级儿童肥胖超重情况,并试分析鹤壁市肥胖儿童NAFLD与VAI之间的关系,以期能够为该病儿童患者分层筛查提供理论依据。

1 资料与方法

1.1 一般资料

选择鹤壁市疾病预防控制中心2020年5月至

2021年5月期间接受体格检查的一年级儿童1013例,均接受超声检查、实验室血脂等指标检查以及常规体格检查,结合体格检查结果筛查出243例超重肥胖儿童作为研究对象,并且保留其VAI完整数据及肝脏超声检查结果,本研究已经鹤壁市疾病预防控制中心伦理委员会许可(批号:20200512),所有受试儿童监护人签署知情同意书。

1.2 观察指标及方法

1.2.1 体格及超重情况

采用软皮尺、人体成分分析仪等对各儿童腰围、BMI等进行测定和计算,其中,BMI为受试者体质量(kg)与身高(m)平方的比值,体质量及身高以电子身高体质量测量仪(精确度:身高1 mm,体质量200 g,准确度等级身高 ± 1 mm,体质量III)测定,参照BMI对肥胖与超重儿童的筛查标准^[8]筛选出受试者中肥胖超重儿童。

1.2.2 NAFLD筛查

对筛选出的各肥胖超重儿童行肝脏超声检查,并依据NAFLD相关影像学诊断^[9],结合肝脏超声结果进行NAFLD筛选。

1.2.3 相关基础生化指标检测

取各肥胖超重儿童5 mL静脉空腹时血液,EDTA抗凝,有效离心半径15 cm,1 500 r/min常温下离心15 min,血清分离后以全自动生化分析仪对其低密度脂蛋白胆固醇(Low density lipoprotein cholesterol, LDL-C)、TG、总胆固醇(Total cholesterol, TC)、HDL-C等血脂有关指标进行检测。

1.2.4 VAI指标计算

由各肥胖超重儿童测得的HDL-C、TG、腰围及BMI数值进行对应VAI水平计算^[10]。

女童: $VAI = WC(\text{cm}) / ((BMI \times 1.89 + 36.58) \times TG / 0.81 \times 1.52 / HDL-C)$

男童: $VAI = WC(\text{cm}) / ((BMI \times 1.88 + 39.68) \times TG / 1.03 \times 1.31 / HDL-C)$

1.2.5 胰岛素抵抗指数(HOMA-IR)

依据 $HOMA-IR = \text{空腹血糖} \times \text{空腹胰岛素} / 22.5$ 计算并记录各受试者HOMA-IR水平。

1.3 统计学分析

数据资料均采用 SPSS 26.0 分析,其中,腰围、BMI 等符合正态分布的计量资料以平均数±标准差($\bar{X} \pm SD$)表示,进行独立样本 t 检验;TG、HDL-C、TC、HOMA-IR 及 VAI 等偏态分布资料以中位数(四分位数)M(P25~P75)表示,数据进行秩和检验;性别等计数资料则以 $n(\%)$ 表示,采用 χ^2 检验;NAFLD 与 VAI 及其他有意义的指标间的相关性采用 Spearman 或 Pearson 检验进行分析,并以二元 Logistic 回归分析相关危险因素和 NAFLD 间的关系, $P < 0.05$ 代表差异有统计学意义。

2 结果

2.1 儿童肥胖超重及 NAFLD 现状及分组

243 例肥胖超重儿童经肝脏超声检查,依据检查结果筛查出 NAFLD 患儿 46 例,占比 18.93%(46/243),非 NAFLD 患儿 197 例,占比 81.07%(197/243),并依据上述筛选结果将其分为 NAFLD 组和非 NAFLD 组。

2.2 分析合并 NAFLD 肥胖超重儿童基本临床特征

两组患儿性别、VAI、腰围、HDL-C、BMI、HOMA-IR 及 TG 有显著差异($P < 0.05$),其中,NAFLD 组患儿男童比例、VAI、腰围、BMI、HOMA-IR 及 TG 均显著高于非 NAFLD 组,HDL-C 显著低于非 NAFLD 组($P < 0.05$),两组年龄、TC 及 LDL-C 水平差异无统计学意义($P > 0.05$),见表 1。

表 1 超重肥胖患儿患 NAFLD 基本特征分析

Table 1 Basic characteristics of NAFLD in overweight and obese children

指标	非NAFLD组	NAFLD组	合计	$\chi^2/t/z$	P
性别/ $n(\%)$					
女	103(52.28)	14(30.43)	117(48.15)	7.13	0.01
男	94(47.72)	32(69.57)	126(51.85)		
BMI/(kg/m^2)	18.66±2.49	22.22±2.26	19.34±2.82	8.86	0.00
年龄/岁	6.84±0.37	6.80±0.40	6.83±0.38	-0.54	0.59
腰围/cm	62.07±6.58	69.97±6.40	63.56±7.24	7.37	0.00
HDL-C/(mmol/L)	1.48±0.22	1.39±0.17	1.47±0.21	-4.51	0.00
TC/(mmol/L)	4.48±0.57	4.47±0.74	4.47±0.58	-0.07	0.79
LDL-C/(mmol/L)	2.44±0.37	2.58±0.56	2.46±0.41	-1.90	0.06
TG/(mmol/L)	0.68±0.19	0.88±0.22	0.71±0.21	-6.32	0.00
HOMA-IR	1.81±0.56	2.02±0.43	1.85±0.68	-4.08	0.00
VAI	0.65±0.16	0.73±0.35	0.66±0.28	-2.25	0.03

2.3 超重肥胖患儿 VAI、相关实验室指标与其 NAFLD 间的相关性

采用 Spearman 秩相关分析得知,肥胖超重儿童 NAFLD 与 HDL-C($r = -0.29$)呈显著负相关($P < 0.01$),与 TG($r = 0.41$, $P < 0.01$)、HOMA-IR($r = 0.26$, $P < 0.01$)和 VAI($r = 0.15$, $P < 0.05$)呈显著正相关,见表 2。

表 2 超重肥胖患儿 VAI、相关实验室指标与 NAFLD 的相关性

Table 2 Correlation between VAI, laboratory indicators and NAFLD in overweight and obese children

因素	NAFLD	HDL-C	TC	LDL-C	TG	HOMA-IR	VAI
NAFLD	1.00	-0.29**	-0.00	0.12	0.41**	0.26**	0.15*
HDL-C	-0.29**	1.00	-0.28**	-0.02	-0.13*	-0.28**	-0.12
TC	-0.00	-0.28**	1.00	0.39**	0.09	-0.17*	0.21**
LDL-C	0.12	-0.02	0.39**	1.00	0.24**	0.22**	0.18**
TG	0.41**	-0.13*	0.09	0.24**	1.00	0.25**	0.43**
HOMA-IR	0.26**	-0.28**	-0.17*	0.22**	0.25**	1.00	0.19**
VAI	0.15*	-0.12	0.21**	0.18**	0.43**	0.19**	1.00

注:*代表对应检验值 $P < 0.05$,**代表对应检验值 $P < 0.01$

2.4 超重肥胖患儿 VAI 与其 NAFLD 间的关系分析

由于 VAI 为 HDL-C、TG、腰围及 BMI 等计算所得,故排除 HDL-C、TG、腰围及 BMI 等等混杂因素对 VAI 的影响,仅将 VAI、性别和 HOMA-IR 作为自变量,NAFLD 为因变量进行二元 Logistic 回归分析可知,肥胖超重儿童性别、VAI 及 HOMA-IR 均与其是否患 NAFLD 有密切关系,其中,男童、VAI 及 HOMA-IR 水平上升均可引起患儿患 NAFLD 的概率显著增加($P < 0.05$),见表 3。

表 3 超重肥胖儿童 VAI 与 NAFLD 间的相关性

Table 3 Correlation between VAI and NAFLD in overweight and obese children

影响因素	β	Wald 值	P	95% CI
性别	2.12	19.41	0.00	3.25~21.44
VAI	3.94	16.32	0.00	7.60~348.06
HOMA-IR	2.63	15.08	0.00	3.68~52.31

注:因变量:NAFLD

3 讨论

NAFLD 的形成涉及与应激、环境、遗传以及代谢等有关的疾病,具体机制尚无系统性的明确解释,现多以二次打击学说为主要解释,即患者出现胰岛素抵抗等导致大量脂质在肝脏内贮集,引起单纯性脂肪肝的第一重打击;脂质过氧化、应激氧化等因素造成肝脏细胞损伤,而诱导非酒精脂肪性肝炎发生的第二重打击,双重打击引起的游离自由基、瘦素及胰岛素抵抗和内脏堆积过多脂肪等共同促进了 NAFLD 的发生^[1]。相关流行病学发现^[2],NAFLD 在全球成年人人群中约有 20%~30% 患病率,而在学龄儿童中,NAFLD 发病率可达 11%~29%,其中,肥胖超重儿童中 NAFLD 检出率可高达 40% 及以上,严重威胁其生活及未来,故关注肥胖超重儿童代谢相关疾病 NAFLD 发生情况,分析其危险因素,对寻求早期分层诊断参考指标十分必要^[13]。

本研究 1013 例体检儿童中,共检出肥胖超重儿童 243 例,占比 23.99%,其中,NAFLD 患儿 46 例,占比 18.93%,较林先强等^[14]研究中 NAFLD 患儿检

出占比低,可能是由于其选取对象主要为单纯性肥胖患儿,且患儿年龄主要为8~14岁儿童,本研究为对NAFLD早期筛查,针对性选取了一年级学生为对象,而NAFLD本身发病在青春期前具有明确的年龄正向相关性^[15]。女童体内雌激素较男童含量高,而其本身对脂肪在机体内的分布具有保护效果,故而出现女童NAFLD检出明显较男童低的趋势^[16];HDL-C、TC、LDL-C及TG作为临床常规血脂指标,TG水平上调以及HDL-C的下调均是脂质代谢异常的危险因素^[17],而HOMA-IR作为胰岛素抵抗的临床评估指标,较高的HOMA-IR直接呈现出体内第一重打击存在的程度,此外胰岛素抵抗可对肾素-血管紧张素体系、糖和脂质代谢系统等产生影响,提升TG机体合成和脂肪动员水平,促进代谢综合征和脂肪肝脏堆积的发生,最终导致NAFLD^[18]。国外有学者研究指出,性别、腰围和BMI作为与机体脂肪变性具有一定预测价值的指标,高BMI、低HDL男童发生脂肪变性的风险更高,与本研究对肥胖超重儿童NAFLD基本特征分析相关结果一致^[19],国内也有学者研究发现^[20]:NAFLD不同性别患儿BMI、腰围、TG均较正常肥胖超重儿童有显著差异,其中男童血压和HDL-C也与NAFLD有关,提示性别也参与到了患者脂质代谢及血压异常改变和肥胖等病理和生理改变中,各因素互相、综合影响了NAFLD发生的病理性改变进程,与本研究结果也具有一致性。本研究另将HDL-C、TG、腰围及BMI数值综合计算结果的VAI单独对NAFLD分组进行回归分析,发现VAI与NAFLD呈显著正相关,提示VAI在综合影响因素中对肥胖超重患儿NAFLD的发生有显著影响,此外李印东等^[21]研究还发现,作为HDL-C、TG、腰围及BMI数值综合计算的结果,VAI与不同性别儿童NAFLD的发生均呈现出良好的正相关关系,且VAI分位数等级越高,超重肥胖儿童患NAFLD的风险也随之升高,与本研究结果一致。另有学者发现^[22],在青少年及儿童中,NAFLD发生早期即表现出了肝内脂肪含量的增高,且后者与患者血糖、HDL以及腰围密切相关,可依据患者肝内脂肪情况对NAFLD进行预测,进一步证实了NAFLD早期筛查从肝脏脂肪堆积入手的合理性。然而本研究未对不同程度NAFLD患儿VAI水平进行分析,且选取对象也仅为本市一年级体检儿童,而NAFLD可发生于儿童及青少年各个阶段,且青春期前呈现出年龄正相关趋势,仅一年级患儿可能有所偏颇,后期将扩大纳入年龄范围,并对NAFLD患儿严重程度进行分层,从多方位对VAI和NAFLD的关系进行计算、分析,并对其分层诊断的价值进行

特异性和敏感性探讨,以期为后期临床应用提供依据。

综上所述,河南省鹤壁市超重肥胖男性儿童比例、HOMA-IR及VAI等升高均可使其患NAFLD风险显著提升,其中,VAI综合了HDL-C、TG、腰围及BMI 4项水平,与患者NAFLD发生有显著相关性,故临床可依据其VAI及相关实验室指标水平进行该病预防、干预,以达到对超重肥胖儿童NAFLD早期预防的目的。

参考文献

- [1] 张姝嫫,程成,祝怡婕,等.超声衰减成像定量诊断非酒精性脂肪肝的应用价值初探讨[J].中国超声医学杂志,2021,37(1):66-69.
ZHANG S P, CHENG C, ZHU Y J, et al. Application value of ultrasonic attenuation imaging in the quantitative diagnosis of nonalcoholic fatty liver [J]. Chinese Journal of Ultrasound Medicine, 2021, 37(1): 66-69.
- [2] DROLZ A, WOLTER S, WEHMEYER M H, et al. Performance of non-invasive fibrosis scores in non-alcoholic fatty liver disease with and without morbid obesity [J]. International Journal of Obesity, 2021, 45(10): 2197-2204.
- [3] SCHWENGER K J P, BOLZON C M, LI C, et al. Non-alcoholic fatty liver disease and obesity: The role of the gut bacteria [J]. European Journal of Nutrition, 2019, 58(5): 1771-1784.
- [4] 叶菁菁,秦瑜,赵丽,等.身体形态指数与新诊2型糖尿病合并非酒精性脂肪肝的关系[J].临床荟萃,2021,36(2):144-148.
YE J J, QIN Y, ZHAO L, et al. Relationship between body shape index and nonalcoholic fatty liver disease in newly diagnosed type 2 diabetes mellitus [J]. Clinical Review, 2021, 36(2): 144-148.
- [5] MOORE J B. From sugar to liver fat and public health: systems biology driven studies in understanding non-alcoholic fatty liver disease pathogenesis [J]. The Proceedings of the Nutrition Society, 2019, 78(3): 290-304.
- [6] VASILIKI V, POLYZOS S A. Menopause and non-alcoholic fatty liver disease: A review focusing on therapeutic perspectives [J]. Current Vascular Pharmacology, 2019, 17(6): 546-555.
- [7] 康晓平,何件根,郭秀花,等.基于体质指数分类的三酰甘油/高密度脂蛋白胆固醇比值与非酒精性脂肪肝发病风险的剂量反应关系[J].中国医药导报,2021,18(4):98-102.
KANG X P, HE Z G, GUO X H, et al. The dose-response relationship between triglyceride/high density lipoprotein cholesterol ratio and risk of nonalcoholic fatty liver disease based on body mass index classification [J]. Chinese Medical Review, 2021, 18(4): 98-102.
- [8] 中国肥胖问题工作组,季成叶.中国学龄儿童青少年超重、肥胖筛查体质指数数值分类标准[J].中华流行病学杂志,2004(2):97-102.
CHINA WORKING GROUP ON OBESITY, JI C Y. Numerical classification Standard of body Mass index for Screening

- Overweight and obesity in Chinese school-age children and adolescents [J]. *Chinese Journal of Epidemiology*, 2004 (2): 97-102.
- [9] 中华医学会肝病学会脂肪肝和酒精性肝病学组, 中国医师协会脂肪性肝病专家委员会. 非酒精性脂肪性肝病防治指南(2018更新版)[J]. *中华肝脏病杂志*, 2018, 26(3): 195-203. Fatty liver And Acoholic Liver Diseas Group, Chinese Medical Association Hepatology Branch, Fatty liver Disease Expert Committee, Chinese Medical Doctor Association. Guidelines for prevention and treatment of non-alcoholic fatty liver disease (2018 Update edition) [J]. *Chinese Journal of Hepatology*, 2018, 26(3): 195-203.
- [10] 卫婧, 奚玉娥, 卢晓翠. 内脏脂肪指数影响因素的多元线性逐步分析[J]. *广东医学*, 2018, 39(6): 912-915. WEI J, XI Y E, LU X C. Multiple linear step by step analysis of the factors influencing visceral fat index [J]. *Guangdong Med*, 2018, 39(6): 912-915.
- [11] 周雨, 张智伟, 王京奇. 从“二次打击”学说探讨中药防治非酒精性脂肪肝的研究进展[J]. *中医药导报*, 2017, 23(18): 109-111. ZHOU YU, ZHANG Z W, WANG J Q. Research progress of TCM prevention and treatment of non-alcoholic fatty liver disease from the theory of "second blow" [J]. *Review of Traditional Chinese Medicine*, 2017, 23(18): 109-111.
- [12] 舒筠然, 李俊琪, 刘琼. 非酒精性脂肪性肝病的流行病学和危险因素分析[J]. *临床肝胆病杂志*, 2019, 35(9): 2085-2090. SHU Y R, LI J Q, LIU Q. Epidemiology and risk factors of nonalcoholic fatty liver disease [J]. *Journal of Clinical Hepatobiliary Diseases*, 2019, 35(9): 2085-2090.
- [13] AHMED I A, MIKAIL M A, MUSTAFA M R, et al. Lifestyle interventions for non-alcoholic fatty liver disease [J]. *Saudi Journal of Biological Sciences*, 2019, 26(7): 1519-1524.
- [14] 林先强, 符清宇, 沙丹. 肥胖儿童非酒精性脂肪性肝病的危险因素分析[J]. *肝脏*, 2019, 24(11): 1306-1309. LIN X Q, FU Q Y, SHA D. Risk factors of non-alcoholic fatty liver disease in obese children. *Liver*, 2019, 24(11): 1306-1309.
- [15] 王永斌, 陆奎英, 苏勇, 等. 非酒精性脂肪肝患者肝功能、氧化应激水平变化及临床意义[J]. *检验医学*, 2020, 35(9): 903-907. WANG Y B, LU K Y, SU Y, et al. Clinical significance of liver function and oxidative stress in patients with nonalcoholic fatty liver disease [J]. *Laboratory Medicine*, 2020, 35(9): 903-907.
- [16] 梁学军, 巩纯秀, 刘莹, 等. 儿童2型糖尿病合并非酒精性脂肪性肝病的特征及相关因素分析[J]. *中华糖尿病杂志*, 2018, 10(7): 482-486. LIANG X J, GONG C X, LIU Y, et al. Analysis on the characteristics and related factors of type 2 diabetes mellitus complicated with non-alcoholic fatty liver disease in children [J]. *Chinese Journal of Diabetes*, 2018, 10(7): 482-486.
- [17] 郭奕瑞, 张莉. 血脂异常与非酒精性脂肪肝病关系前瞻性队列研究[J]. *中国公共卫生*, 2021, 37(1): 141-144. GUO Y R, ZHANG L. Prospective cohort study on the relationship between dyslipidemia and nonalcoholic fatty liver disease. *Chinese Journal of Public Health*, 2021, 37(1): 141-144.
- [18] 吕卓超, 蔡海芳, 何春霞, 等. 丽水地区儿童肥胖和NAFLD的流行现状及危险因素分析[J]. *中国妇幼健康研究*, 2019, 30(6): 673-677. LV Z C, CAI H F, HE C X, et al. Prevalence and risk factors of childhood obesity and NAFLD in Lishui area [J]. *China Maternal and Child Health Research*, 2019, 30(6): 673-677.
- [19] ELIF O, BAHADIR Y. Obese boys with low concentrations of high-density lipoprotein cholesterol are at greater risk of hepatosteatosis[J]. *Hormones (Athens)*, 2019, 18(4): 477-484.
- [20] 陈新春, 寇永妹, 刘晓璐, 等. 唐山市7~14岁肥胖儿童非酒精性脂肪肝流行现状及危险因素初步分析[J]. *中国儿童保健杂志*, 2021, 29(6): 669-673. CHEN X C, KOU Y M, LIU X L, et al. Prevalence and risk factors of nonalcoholic fatty liver disease in obese children aged 7-14 years in Tangshan City [J]. *Chinese Journal of Child Health*, 2021, 29(6): 669-673.
- [21] 李印东, 李梦龙, 段军伟, 等. 北京市超重肥胖儿童内脏脂肪指数与非酒精性脂肪肝的关系[J]. *中国学校卫生*, 2021, 42(5): 659-662. LI Y D, LI M L, DUAN J W, et al. Relationship between visceral fat index and nonalcoholic fatty liver in overweight and obese children in Beijing [J]. *Chinese Journal of School Health*, 2021, 42(5): 659-662.
- [22] 柳挺, 王卿, 裴林国, 等. 南阳地区回族学龄期儿童非酒精性脂肪肝与脂肪含量关系[J]. *解剖学杂志*, 2018, 41(2): 182-185. LIU T, WANG Q, PEI L G, et al. Relationship between non-alcoholic fatty liver and fat content in Hui school-age children in Nanyang area [J]. *Chinese Journal of Anatomy*, 2018, 41(2): 182-185.