·现场调查·

中国6市7～16岁中小学生血脂水平现状调查

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【摘要】 **目的** 了解中国汉族学生血脂水平现状，为制定儿童青少年血脂异常防治策略提供依据。**方法** 选择有地域代表的北京、天津、杭州、上海、重庆和南宁6市2010年在校7～16岁中小学生共20 191名（男性10 669名，女性9522名）为调查对象；按血脂测定标准化方法测定空腹甘油三酯（TG）、总胆固醇（TC）、低密度脂蛋白胆固醇（LDL-C）和高密度脂蛋白胆固醇（HDL-C）水平，计算非高密度脂蛋白胆固醇（non-HDL-C）。**结果** （1）7～16岁儿童青少年每岁年龄组的TG（95百分位数，P_{95}）为1.26～1.88 mmol/L，TC（P_{95}）为4.80～5.46 mmol/L，LDL-C（P_{95}）为2.67～3.27mmol/L，non-HDL-C（P_{95}）为3.36～3.91 mmol/L，与年龄无明显相关性（$P>0.05$）；HDL-C（P_5）波动于1.08～0.83 mmol/L，HDL-C与年龄的相关性分析提示差异有统计学意义（$P<0.01$，$r=-0.274$）。（2）各年龄组及男女性别间，肥胖组TG、TC、LDL-C、non-HDL-C水平均高于非肥胖组，但HDL-C水平低于非肥胖组；肥胖组单项及多项血脂异常发生率显著高于非肥胖组，差异均有统计学意义（$P<0.01$）。（3）按地域分组后，TG异常率由高到低依次为北部（10.4%）、中西部（9.7%）、东部（8.3%）地区，TC异常率依次为中西部（6.0%）、北部（5.2%）、东部（4.8%）地区，LDL-C异常率依次为北部（3.1%）、东部（2.6%）、中西部（0.9%）地区，non-HDL-C异常率依次为中西部（6.5%）、北部（4.2%）、东部（3.6%）地区，HDL-C异常率依次为中西部（14.2%）、北部（5.7%）、东部（5.5%）地区，差异有统计学意义（$P<0.05$）。（4）根据美国儿科学会的高脂血症标准，总体调查人群高TG、TC、LDL-C、non-HDL-C血症发生率分别为9.4%、5.4%、2.2%、4.8%，低HDL-C血症发生率为8.6%。**结论** 在儿童青少年期，年龄不是影响TG、TC、LDL-C水平的主要因素，但HDL-C水平随年龄增长有一定下降趋势；非肥胖组血脂水平明显优于肥胖组，且东部地区优于北部及中西部。

【关键词】 血脂；非高密度脂蛋白胆固醇；学龄期儿童；肥胖

Survey on the levels of lipids in school-aged children of Beijing, Tianjin, Hangzhou, Shanghai, Chongqing and Nanning cities

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【**Abstract**】 **Objective** To investigate the lipid levels of Han ethnicity Chinese children at school-age, to provide objective data for the formulation of prevention and management strategy regarding dyslipidemia among children and adolescents. **Methods** 20 191 children (with 10 669 boys and 9522 girls) aged 7 to 16 years old from 6 representative geographical areas, including Beijing, Tianjin, Hangzhou, Shanghai, Chongqing and Nanning, were surveyed in a randomly selected

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clustered sample in China. Data on fasting blood triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) levels were measured. Non-high-density lipoprotein cholesterol (non-HDL-C) levels were calculated with data collection, entry, and collation were under the same criteria. **Results** (1) In the 7–16 year-old group, TG(P_{95}) fluctuated between 1.26 mmol/L and 1.88 mmol/L, while TC(P_{95}) was between 4.80 mmol/L and 5.46 mmol/L. LDL-C(P_{95}) was between 2.67 mmol/L and 3.27 mmol/L while non-HDL-C (P_{95}) was between 3.36 mmol/L and 3.91mmol/L, sugesting that age did not seem to be an affecting factor for the lipid level ($P>0.05$). The level of HDL-C(P_5) fluctuated between 1.08 mmol/L and 0.83 mmol/L, and the dependability analysis on HDL-C and age showed statistically significant difference ($P<0.01$, $r=-0.274$). (2) In the 7–9 year-old group, the levels of TG, TC, LDL-C and non-HDL-C of boys were lower but the HDL-C level was higher than in girls. However, in the 10–16 year-old group, the levels of five lipids of boys were all lower than in girls, with all the differences statistically significant ($P<0.05$). (3) The levels of TG, TC, LDL-C and non-HDL-C in the obese group were significantly higher than those in non-obesity group, as HDL-C was significantly lower than in non-obese group ($P<0.01$). Incidence rates of single and multiple dyslipidemia in obese group were significantly higher than in non-obese group ($P<0.01$). (4) Grouped by region, the abnormal rates of TG were descending, with the ranking as North (10.4%), Midwest (9.7%) and East (8.3%), while the abnormal rates of TC were descending with the ranking as Midwest (6.0%), North (5.2%) and East (4.8%). The abnormal rates of LDL-C were descending as the ranking of North (3.1%), East (2.6%) and Midwest (0.9%), with the abnormal rates of non-HDL-C were descending as Midwest (6.5%), North (4.2%) and East (3.6%). The abnormal rates of HDL-C were descending as Midwess (14.2%), North (5.7%) and East (5.5%). All the differences in the above-said items were statistically significant ($P<0.05$). (5) According to the standards of hyperlipidemia formulated by the American Academy of Pediatrics, the incidence rates of abnormal TG, TC, LDL-C, non-HDL-C, HDL-C were 9.4%, 5.4%, 2.2%, 4.8%, 8.6% respectively. **Conclusion** (1) Levels of lipids were affected by many factors, but age was not one of them in children and adolescents. However, HDL-C was declining along with the increase of age, to some extent. (2) Girls had a relatively protective tendency through the increasing HDL-C level when they entered the puberty years. (3) Lipids levels in non-obese group were significantly better than the obese group. (4) The lipids levels of children and adolescents in the Eastern region of the country were better than that in the northern and mid-western areas.

【Key words】 Lipids; Non-high-density lipoprotein cholesterol; Children of school-age; Obesity

国际糖尿病联盟(IDF)对成年人[1]和儿童青少年[2]代谢综合征(MS)的新定义均以中心性肥胖为前提,并将高密度脂蛋白胆固醇(HDL-C)下降和甘油三酯(TG)升高作为独立组分,突出脂代谢紊乱对胰岛素抵抗(IR)和预测心血管疾病(CVD)风险的重要性。新近美国儿科学会(AAP)推荐非高密度脂蛋白胆固醇(non-HDL-C)为降脂和防止CVD的重要靶标之一[3]。但目前国际、国内儿童血脂谱异常标准不统一[2-4],且迄今关于我国儿童血脂谱的变化也仅有少量小样本或地方性的资料[5-7],尤其是缺少non-HDL-C水平的研究。为此本研究以具有地域代表的北京、天津、杭州、上海、重庆和南宁6市2010年在校中小学生为调查对象,以了解该人群血脂水平,为制定我国儿童青少年血脂异常防治策略提供理论依据。

对象与方法

1. 研究对象:依据我国教育部数据,编制北京、天津、杭州、上海、重庆和南宁6个市学校清单,采用整群抽样方法,在每一个市分别选取城乡中小学校,所选学校全部在校学生共计22 197名列为调查对象,剔除部分不完整和极端数据,最终获得有效样本20 191(男性10 669,女性9522)人;其中北部地区(北京和天津)6221(男性3208,女性3013)人,东部地区(上海和杭州)6981(男性3892,女性3089)人,中西部地区(重庆和南宁)6989(男性3569,女性3420)人。研究对象排除肿瘤、内分泌及代谢性疾病、严重心肝肾等疾病和其他慢性疾病如肺结核、哮喘、风湿病等。被调查者均由本人及家长填写调查问卷和签署知情同意书。

2. 研究方法:

(1)问卷调查:调查问卷包括个人及家庭的生活方式信息,如母亲妊娠期、出生体重、喂养方式、饮食习惯、作息规律以及家族或个人肥胖危险因素史等。

(2)体格检查:由经过统一培训的专业人员测量所有对象的体质量和身高,计算BMI(kg/m^2),并进行全身体格检查。按照2003年中国肥胖工作组制定的"中国学龄儿童青少年超重、肥胖筛查体重指数值分类标准"[8],将研究对象分为肥胖组(1392人)和非肥胖组(18 799人)。

(3)血脂测定:调查对象均禁食禁水10 h抽取清晨空腹静脉血,分离血浆,应用标准方法测定TG、总胆固醇(TC)、低密度脂蛋白胆固醇(LDL-C)和HDL-C四项血脂水平。统一采用德国罗氏诊断有限公司的全自动生化分析仪及试剂测定。参照IDF定义将研究对象分为两组[2]:≥10岁组15 169(男性8010,女性7159)人;<10岁组5022(男性2659,女性2363)人。

(4)诊断标准:血脂异常参照AAP[3]和儿童青少年血脂异常防治专家共识[4]标准,即TG≥1.47 mmol/L、TC≥5.18 mmol/L、LDL-C≥3.37 mmol/L、non-HDL-C(为TC值减HDL-C值)≥3.76 mmol/L、HDL-C<1.03 mmol/L。

(5)质量控制:所有数据均由专业人员统一录入,双人核对。对现场采样、实验室检测以及数据清理各环节均进行质量控制。采集血液样本的现场工作人员和承担检验的实验室工作人员均经过统一培训和考核;检测仪器经过计量认证;统一提供检测试剂;测定样本指标的同时测定质控血清,其结果必须在既定范围内。按统一的数据清理规则进行血脂数据整理。

3. 统计学分析:采用SPSS 16.0统计学软件处理和分析数据,大样本正态数据组间比较用t检验或者方差分析,$P<0.05$为差异有统计学意义;并统计各项血脂的百分位数,其中HDL-C的百分位数分布应用LM Schartmaker制作光滑曲线。

结　果

根据国际胆固醇教育计划(NCEP)[9],TG、TC、LDL-C、non-HDL-C水平以95百分位数(P_{95})为异常临界点,HDL-C水平则以P_5为异常临界点。本研究结果显示,在7~16岁儿童青少年中,每岁年龄组TG(P_{95})水平男性为1.26~1.88 mmol/L,女性1.43~1.88 mmol/L;TC(P_{95})水平男性4.80~5.46 mmol/L,女性5.12~5.42 mmol/L;LDL-C(P_{95})水平男性2.67~3.27 mmol/L,女性2.92~3.25 mmol/L;non-HDL-C(P_{95})水平男性3.36~3.89 mmol/L,女性3.36~3.98 mmol/L。4项血脂水平均与年龄无明显相关性($P>0.05$)。每岁年龄组HDL-C(P_5)水平男性1.07~0.83 mmol/L,女性1.08~0.88 mmol/L;HDL-C水平与年龄相关性有统计学意义($r=-0.274$, $P<0.01$),但随年龄增长有一定下降趋势(表1和图1、2)。

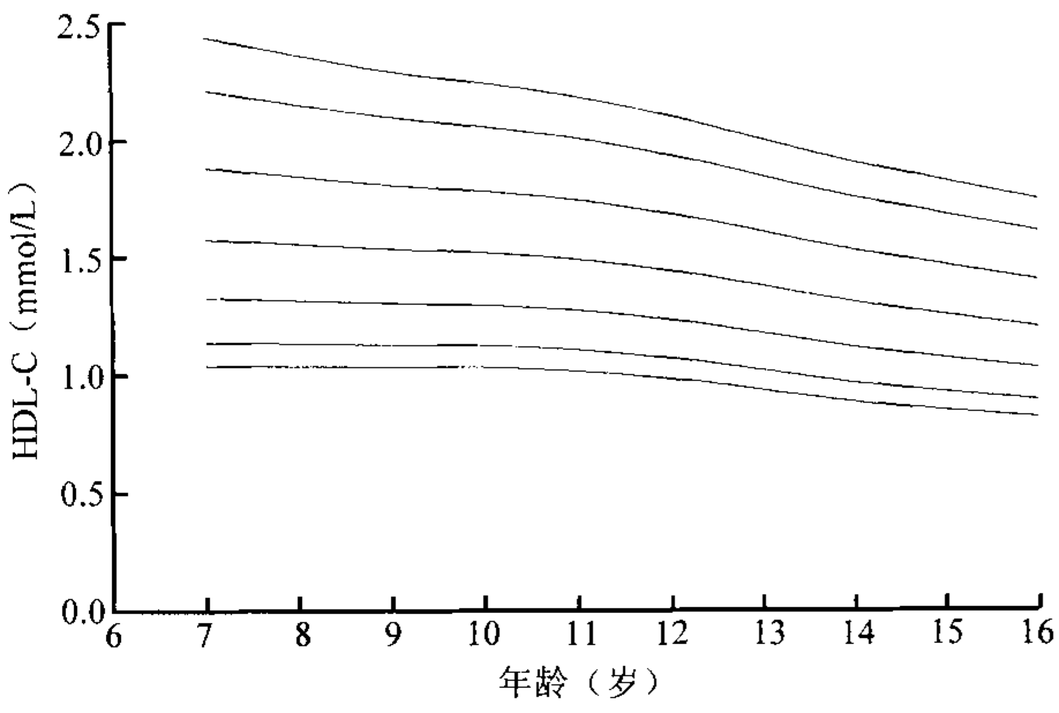

图1 不同年龄组男性HDL-C百分位数分布

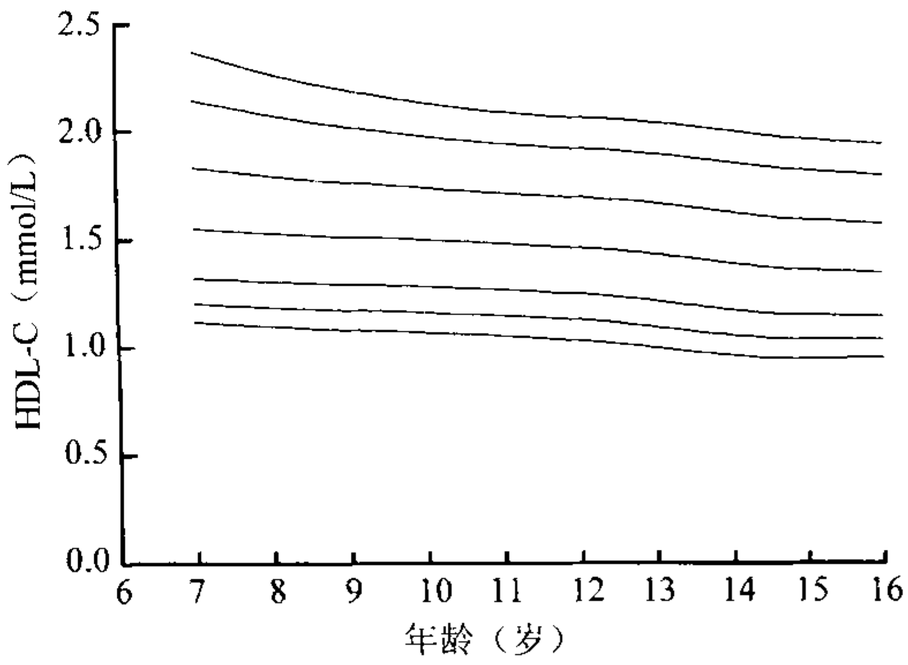

图2 不同年龄组女性HDL-C百分位数分布

表1 2010年我国6市20 191名7~16岁儿童血脂水平(mmol/L)

年龄(岁)	人数	TG(P_{95})		TC(P_{95})		LDL-C(P_{95})		non-HDL-C(P_{95})		HDL-C(P_5)	
		男	女	男	女	男	女	男	女	男	女
7~	1 481	1.36	1.43	5.14	5.18	3.01	3.25	3.36	3.36	1.05	1.08
8~	1 672	1.26	1.51	4.86	5.30	2.67	3.15	3.54	3.72	1.05	1.07
9~	1 869	1.62	1.60	5.08	5.20	2.91	3.11	3.46	3.70	1.07	1.01
10~	2 081	1.70	1.75	5.36	5.37	3.13	3.21	3.57	3.60	1.05	1.02
11~	1 825	1.74	1.84	5.46	5.20	3.27	2.95	3.75	3.80	1.04	1.02
12~	2 154	1.70	1.88	5.17	5.12	3.05	3.03	3.89	3.70	1.01	1.04
13~	2 679	1.76	1.81	5.12	5.26	2.87	3.09	3.63	3.59	0.96	1.00
14~	2 998	1.68	1.77	5.02	5.42	2.91	3.13	3.68	3.77	0.88	0.88
15~	2 043	1.76	1.71	5.08	5.12	2.84	2.92	3.72	3.98	0.84	0.89
16	1 389	1.88	1.71	4.80	5.26	2.78	3.03	3.86	3.96	0.83	0.93
合计	20 191	1.68	1.73	5.15	5.25	2.97	3.09	3.68	3.77	0.94	0.97

<10岁年龄组中，男性TG、TC、LDL-C和non-HDL-C水平低于女性，但HDL-C水平却高于女性，差异有统计学意义（$P<0.05$）；≥10岁组年龄组，男性TG、TC、LDL-C、non-HDL-C和HDL-C均低于女性，差异有统计学意义（$P<0.01$）。

各年龄组及性别间，肥胖组TG、TC、LDL-C和non-HDL-C水平均高于非肥胖组，但HDL-C低于非肥胖组，差异有统计学意义（$P<0.01$）（表2）。表3显示肥胖组与非肥胖组各项血脂异常的比较，差异有统计学意义（$P<0.01$）。

表2　肥胖组与非肥胖组血脂水平比较

血脂(mmol/L)	肥胖组(n=1392)	非肥胖组(n=18 799)	t值	P值
TG	1.26±0.72	0.90±0.54	179.84	0.00
TC	4.20±1.16	3.91±1.01	6.30	0.01
LDL-C	2.37±0.67	2.00±0.57	37.15	0.00
non-HDL-C	2.90±1.19	2.43±0.95	23.62	0.00
HDL-C	1.31±0.39	1.49±0.42	14.80	0.00

表3　肥胖组与非肥胖组血脂异常比较

项目	肥胖组(n=1392)	非肥胖组(n=18 799)	χ^2值	P值
高TG	402	1517	1763.23	0.00
高TC	143	956	252.44	0.00
高LDL-C	85	654	417.12	0.00
高non-HDL-C	186	772	869.31	0.00
低HDL-C	254	1462	609.09	0.00
血脂异常项数				
1	347	2593	4789.33	0.00
2	143	648	2779.17	0.00
3	73	291	1522.25	0.00
4	47	66	1803.41	0.00
5	6	7	233.12	0.00

按地域分组后，TG异常率由高到低依次为北部（10.4%）、中西部（9.7%）、东部（8.3%）地区，TC异常率依次为中西部（6.0%）、北部（5.2%）、东部（4.8%）地区，LDL-C异常率依次为北部（3.1%）、东部（2.6%）、中西部（0.9%）地区，non-HDL-C异常率依次为中西部（6.5%）、北部（4.2%）、东部（3.6%）地区，HDL-C异常率依次为中西部（14.2%）、北部（5.7%）、东部（5.5%）地区，差异均有统计学意义（P值均<0.05）（图3）。

根据AAP标准[3]，本次总体调查人群高TG、TC、LDL-C、non-HDL-C发生率分别为9.4%、5.4%、2.2%和4.8%；低HDL-C发生率为8.6%。

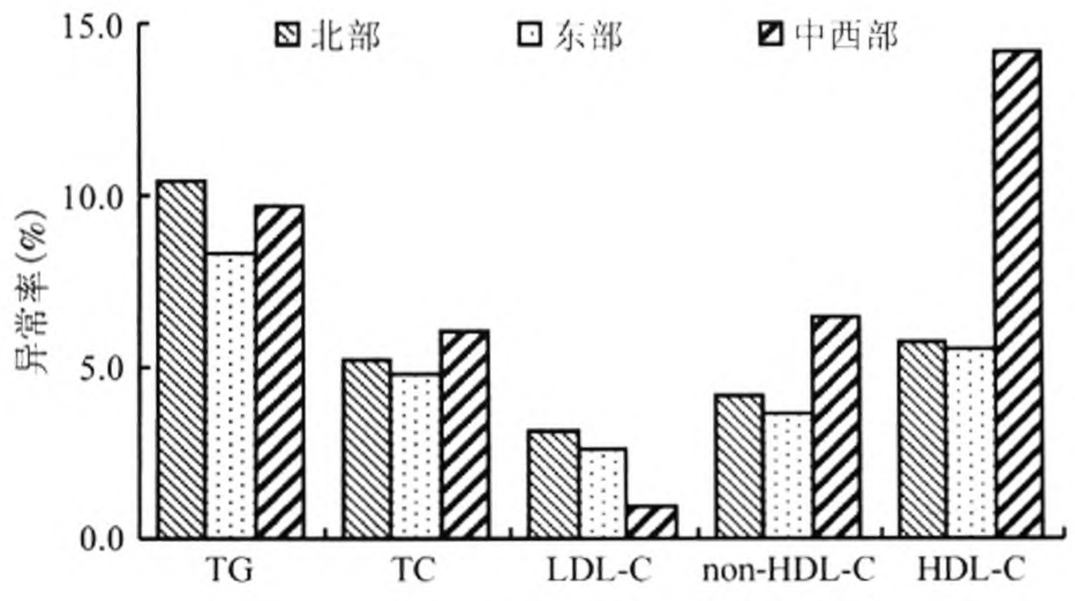

图3　我国不同地域20 191名7～16岁儿童各项血脂异常率比较

讨　论

低HDL-C作为MS的重要诊断指标，其切点存在众多争议。国内儿童青少年血脂异常防治专家共识[4]标准为HDL-C≤1.04 mmol/L，而AAP及IDF均推荐HDL-C<1.03 mmol/L。本研究发现调查人群HDL-C水平较低，P_5仅0.95 mmol/L，这与国内Wang等[10]的研究一致。本次调查HDL-C水平1.03 mmol/L约为P_{10}，此切点已体现了当前早识别、早干预风险人群的理念，有利于在儿童青少年期重视血脂水平，早期逆转MS。此外，统一采用AAP及IDF标准有利于与其他国家儿童青少年血脂研究资料比较。本次调查还发现儿童青少年随年龄增长HDL-C水平呈一定下降趋势，符合文献[11,12]的报道。本研究中<10岁年龄组，女性HDL-C水平低于男性，而≥10岁组，女性却高于男性，这也与国内外其他研究[11,13,14]一致。提示青春期后女性存在保护性HDL-C水平相对升高的可能。

Non-HDL-C代表除HDL-C以外的各种脂蛋白胆固醇的总和，包括LDL-C和极低密度脂蛋白胆固醇（VLDL-C）等。本研究发现，7～16岁学龄期儿童中高non-HDL-C发生率总体为4.80%，其中肥胖儿童高达13.36%。Mahajan等[15]研究显示，non-HDL-C水平较其他血脂风险因子更能预示冠心病的发生。而Boekholdt等[16]对62 154例使用他汀类药物患者的Meta分析证实了non-HDL-C水平与将来发生CVD事件最具有相关性。AAP也认为在儿童期，non-HDL-C作为识别CVD危险因素高危人群的指标要好于LDL-C、HDL-C等，并将其列为MS组分和作为降脂和防止CVD的重要靶标之一[3]。儿童期高non-HDL-C水平应引起重视。

血脂异常与肥胖密切相关。本研究中肥胖组除non-HDL-C水平外，TG、TC、LDL-C也明显高于非肥胖组，而HDL-C明显低于非肥胖组。另外，单项及多项血脂异常发生率肥胖组显著高于非肥胖组，这与国内外多项研究相符合[11,17,18]。肥胖与血脂异

常均为MS的重要组分，并与成年后心脑血管疾病的发生有很大相关性。因此，肥胖儿童的血脂异常更应引起高度重视。

本研究还发现，儿童青少年血脂各指标，东部地区优于北部及中西部，可能与东部地区饮食结构中水产品及新鲜蔬菜类比例相对较高有关。

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