

# 上海市松江区成人2型糖尿病确诊状况与体力活动的关联

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**【摘要】 目的** 比较上海松江区社区血糖正常人群2型糖尿病(type 2 diabetes mellitus, T2DM)既往确诊患者和筛检确诊患者的体力活动情况,为糖尿病的早期筛查及管理提供依据。**方法** 基于2016—2017年上海市高峰松江队列的基线调查数据,将研究对象分为血糖正常组、糖尿病既往确诊组和筛检确诊组。采用国际体力活动调查表(International Physical Activity Questionnaire, IPAQ)评估体力活动。对3组人群采用2:1:1倾向性评分匹配法控制性别和年龄。广义线性模型和非条件Logistic回归模型分别用于比较组间体力活动水平及参与率。**结果** 36 226名研究对象中T2DM现患率为14.5%,其中58.7%的患者知晓患病。不同性别3组人群的总体活动量及活动水平分级差异均无统计学意义,但静态行为差异有统计学意义( $P<0.05$ ),既往确诊组最高,平均为235~273 min/天。男性3组人群各类体育运动的参与率及运动量差异均无统计学意义。女性中,7.6%的筛检患者参加剧烈运动,平均运动量为220 MET-min/周,居首位,既往确诊组次之,参与率为5.8%,平均运动量为152 MET-min/周;既往确诊组中等强度运动的参与率和活动量最高,分别为23.7%和373 MET-min/周,筛检确诊组次之,分别为23.2%和357 MET-min/周。**结论** 研究人群中T2DM患病率高,知晓率低,总体活动量及活动水平均处于较低水平,需加强T2DM的早期筛查及现患病例的健康教育和健康管理。

**【关键词】** 2型糖尿病(T2DM); 运动; 诊断; 疾病获知; 体力活动; 上海市,松江区

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## Association of physical activities in adults with diagnosis of type 2 diabetes in Songjiang District, Shanghai

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**【Abstract】 Objective** To compare physical activities in adults by diagnosis of type 2 diabetes mellitus (T2DM) in Songjiang District of Shanghai, and thus provide evidence for early detection and management of the disease. **Methods** The members of the Gaofeng cohort study recruited in 2016 to 2017 in Songjiang District of Shanghai were classified into healthy group, previously-diagnosed T2DM group and screened T2DM group based on the baseline data. Physical activities were assessed using the International

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Physical Activity Questionnaire (IPAQ). Propensity score matching was applied by 2:1:1 to control confounding effects of sex and age. Generalized linear model and unconditional logistic regression model were applied to compare physical activity levels of the 3 groups. **Results** Of 36 226 eligible subjects, 14.5% were diagnosed with T2DM, among which only 58.7% were aware of the prevalence of the disease. Regardless of sex, no significant difference was observed for overall intensity and levels of physical activities across the three groups. However, a significant difference was observed for sedentary behaviors ( $P < 0.05$ ), with the longest sedentary time (235–273 minute/day) observed in previously-diagnosed patients. In men, no significant difference was observed for participation rate, intensity and levels of exercise among the three groups. In women, 7.6% of screened patients participated in vigorous exercise, achieving an average intensity of 220 MET-min/week, while in previously diagnosed patients the participation rate was 5.8% and the average intensity was 152 MET-min/week. Regarding the moderate exercise, the participation rate was 23.7% in previously diagnosed patients and 23.2% in screened patients, with average intensity of 373 MET-min/week and 357 MET-min/week, respectively. **Conclusion** The high prevalence and low awareness rate of T2DM in our population, as well as the low level of physical activities in T2DM patients, highlight the importance of early detection of T2DM and health education and management of prevalent patients.

**【Key words】** diabetes mellitus type 2 (T2DM); exercise; diagnosis; awareness of disease; physical activity; Shanghai, Songjiang District

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2型糖尿病(type 2 diabetes mellitus, T2DM)是流行最广泛的慢性非传染性疾病之一。2017年我国T2DM患病率为11.2%<sup>[1]</sup>,糖尿病及其并发症的疾病负担重,加强患者健康管理可降低并发症风险<sup>[2]</sup>,减轻疾病负担<sup>[3]</sup>。

运动是T2DM患者控制血糖最为经济有效的方式之一<sup>[4]</sup>,既能降低患者的HbA1c水平<sup>[5]</sup>,还可提升幸福感<sup>[6]</sup>,减轻焦虑<sup>[7]</sup>。运动是一种需要长期坚持的行为,我国成年人的运动量充足者不到45.4%<sup>[8]</sup>,而T2DM患者运动参与率不足10%<sup>[9]</sup>。

疾病风险获知是改善行为生活方式的重要动力。获知疾病风险后,人们往往会做出改变行为生活方式的决定<sup>[10]</sup>。研究显示,T2DM确诊患者相较于未确诊者摄入高糖饮食较少<sup>[11]</sup>。可见,及时诊断不但有利于尽早对患者实施药物治疗,而且可促进患者改善生活方式,实现非药物治疗。多项研究比较了T2DM筛检病例与现患病例的体力活动状况,但结果并不一致。Karjalainen等<sup>[12]</sup>发现,芬兰女性T2DM筛检患者的运动参与率低于既往确诊者。一项基于NHANES的研究发现,T2DM现患病例、未诊断患者及血糖正常人群的运动时长差异无统

计学意义<sup>[13]</sup>。斯里兰卡的一项研究<sup>[14]</sup>发现,既往确诊T2DM患者较筛检病例不活跃者占比略高,但差异无统计学意义。我国健康与养老追踪调查研究显示,T2DM既往确诊患者的运动水平低于血糖正常者<sup>[15]</sup>。

因此,本研究基于具有大样本量的上海市高峰松江队列基线调查数据,在中国人群中比较健康人群、既往确诊和筛检T2DM患者不同类型和强度体力活动的情况,评估T2DM知晓对患者运动行为的影响,为提高T2DM知晓率、加强患者的健康教育和健康管理提供依据。

## 资 料 和 方 法

**研究对象** 本研究基于2016年6月—2017年12月开展的上海高峰松江队列研究基线调查数据。队列研究设计及实施方法详见既往报道<sup>[16]</sup>。该队列以松江区社区人群为研究对象,采用多阶段分层整群抽样方法招募队列成员。根据地理位置及人口规模,在松江区选取2个城区、1个郊区和1个城乡结合部;从各区域中分别随机抽选9、18、16和4个

街道、居委会或行政村,招募在当地居住5年及以上的20~74岁成年人,最终纳入36 410人。

本研究根据国际体力活动问卷的数据清理和异常值剔除原则,剔除95条体力活动信息缺失和1条体力活动数据异常的观测值,以及88名行动不便和日常生活无法自理者,最终纳入36 226名研究对象。本研究获得复旦大学伦理委员会审批(批件号:IRB#2016-04-0586-S)。

**数据采集及体力活动评估** 对所有队列成员进行面访调查和体格检查,收集人口学信息、疾病史、吸烟、饮酒、膳食和体力活动等信息,进行身高、体重、腰围、血压和心率测量以及血脂、空腹血糖和糖化血红蛋白(hemoglobin A1c, HbA1c)检测。计算体重指数(body mass index, BMI),用于衡量全身性肥胖。

体力活动的测量和评估采用国际体力活动调查表(International Physical Activity Questionnaire, IPAQ),该调查表在中国人群中具有较好的信度和效度<sup>[17]</sup>,并在体力活动研究中得到广泛应用<sup>[18]</sup>。体力活动量的评估采用代谢当量值(metabolic equivalent, MET),即活动时与静息时的代谢率比值。设定静息时的代谢率为1 MET,活动时的能量消耗(MET-min/周)=该类活动代谢当量值(MET)×每天运动时间(min)×每周活动频率(天/周)。各类活动的代谢当量值分别为:剧烈运动(跑步、足球、篮球、拳击等引起呼吸心跳显著增加的运动),8 METs;中等强度体育运动(交谊舞、非竞技羽毛球、乒乓球等引起呼吸心跳轻度增加的运动)及骑车,4 METs;步行,3.3 METs;家务劳动,3 METs。体力活动水平分级参考IPAQ工作组推荐的标准:(1)高水平定义为高强度体力活动合计≥3天,且总体力活动水平≥1500 MET-min/周;或3种强度体力活动合计≥7天,且总体力活动水平≥3000 MET-min/周。(2)中水平定义为每天至少进行20 min高强度体力活动,总计≥3天;或每天至少进行30 min中等强度体力活动/步行类活动,总计≥5天;或3种强度体力活动总计≥5天,且总体力活动水平≥600 MET-min/周。(3)低水平定义为未报告任何活动或未达中、高水平标准<sup>[19]</sup>。

采用膳食频率调查表收集研究对象的膳食习惯,基于中国食物成分表计算总能量摄入。中国健康膳食指数(China Health Diet Index, CHDI)的计

算参考中国疾病预防控制中心营养与健康所制定的计算方法,基于2016版中国居民膳食指南膳食推荐摄入量,从各类食物种类、摄入量多少、营养素供能占比等13个维度评价膳食平衡情况<sup>[20]</sup>。

**T2DM诊断标准与相关定义** 根据2015年ADA的诊断标准,符合以下任一条件者可诊断为T2DM:(1)既往已确诊为T2DM者或降糖药使用者;(2)FPG≥7.0 mmol/L;(3)HbA1c≥6.5%;(4)口服糖耐量试验后2 h血糖≥11.1 mmol/L<sup>[21]</sup>。本次研究对象未进行口服糖耐量实验,也未检测餐后2 h血糖,仅根据第1~3条标准分为3组:(1)既往确诊T2DM者;(2)根据本次空腹血糖和HbA1c检测值检出的筛检患者;(3)血糖正常者。

**倾向性评分匹配** 由于3组人群的年龄和性别分布存在较大差异,为去除这些因素的混杂效应,采用倾向性评分匹配(propensity score matching, PSM)方法,以既往确诊T2DM患者为基准,按2:1:1的比例对血糖正常者(对照组)、既往确诊T2DM患者和筛检患者进行年龄和性别匹配。采用最邻近匹配法,精确匹配性别,卡钳值设为0.25,最终4 304例血糖正常者、2 152例既往确诊患者和2 152例筛检患者纳入体力活动的分析和比较。

**统计学分析** 利用SAS 9.4对数据进行清理及分析。根据WHO 2001年发布的世界标准化人口分布(<https://www.who.int/healthinfo/paper31.pdf?ua=1>),对T2DM患病率进行年龄标化,便于与全国患病率水平进行比较。分类变量以 $n(\%)$ 表示,采用 $\chi^2$ 检验进行组间比较;连续型变量以 $M(P_{25}, P_{75})$ 表示,采用Kruskal-Wallis进行组间比较。广义线性模型调整年龄、教育程度和糖尿病家族史,用于评估和比较各组间各类体力活动量,以ls-mean(95%CI)表示;非条件Logistic回归调整年龄、教育程度、高血压、心血管患病情况和糖尿病家族史,用于比较不同年龄组和文化程度者的体育运动参与率,以 $P<0.05$ 为差异有统计学意义。

## 结 果

**匹配前后研究对象的基本情况** 纳入的36 226名研究对象中,T2DM患者5 238人,粗患病率为14.5%,年龄标化患病率为10.5%,既往确诊者3 076人,患病知晓率为58.7%。3组人群的年龄、性

别和文化程度差异有统计学意义( $P<0.01$ ,表1),但吸烟率和饮酒率差异无统计学意义;健康对照组的体育锻炼、高血压和心血管病患病、糖尿病家族史、BMI、腰围、空腹血糖、HbA1c、甘油三酯水平处于较低水平,而文化水平、总能量摄入、健康膳食指数和高密度脂蛋白处于较高水平,3组差异有统计

学意义( $P<0.01$ )。采用PSM匹配后,3组的年龄、性别及文化程度差异无统计学意义,但总能量摄入、健康膳食指数、疾病史、家族史、身体测量和生化检测指标的差异仍有统计学意义(表1)。

表1 PSM前后研究对象的基本情况

Tab 1 Basic characteristics of the study participants before and after PSM [n(%) or M( $P_{25}$ , $P_{75}$ )]										
Characteristics	Before PSM					After PSM				
	Healthy subjects ( $n=30\ 988$ )	Previously diagnosed T2DM ( $n=3\ 076$ )	Screened T2DM ( $n=2\ 162$ )	$\chi^2/H$	$P$	Healthy subjects ( $n=4\ 304$ )	Previously diagnosed T2DM ( $n=2\ 152$ )	Screened T2DM ( $n=2\ 152$ )	$\chi^2/H$	$P$
Demographic characteristics										
Age (y)	57.0 (49.0,64.0)	62.0 (56.0,67.0)	62.0 (55.0,67.0)	985.7	<0.01	62.0 (55.0,67.0)	62.0 (55.0,67.0)	62.0 (55.0,67.0)	0.0	0.99
Sex (male)	12 457 (40.2)	1 331 (43.3)	923 (42.7)	15.1	<0.01	1 834 (42.7)	917 (42.6)	917 (42.6)	0.0	1.00
Educational level				411.2	<0.01				1.9	0.75
Primary school or below	13 841 (44.7)	1 824 (59.3)	1 247 (57.7)			2 466 (57.3)	1 255 (58.3)	1 246 (57.9)		
Junior high school	11 214 (36.2)	928 (30.2)	688 (31.8)			1 370 (31.8)	685 (31.8)	687 (31.9)		
Senior high school or above	5 933 (19.2)	324 (10.5)	227 (10.5)			468 (10.9)	212 (9.9)	219 (10.2)		
Life styles										
Smoking	6 121 (19.8)	629 (20.5)	444 (20.5)	1.5	0.47	882 (20.5)	425 (19.8)	440 (20.5)	0.5	0.77
Drinking	3 817 (12.3)	382 (12.4)	304 (14.1)	5.6	0.06	575 (13.4)	256 (11.9)	302 (14.0)	4.6	0.10
Total energy intake (kcal/d)	935 (696,1 230)	832 (603,1 117)	890 (648,1 176)	197.6	<0.01	882 (641,1 173)	814 (593,1 104)	889 (648,1 176)	42.2	<0.01
China health diet index	71.8 (65.1,78.0)	69.0 (62.3,75.3)	70.3 (63.3,76.6)	251.9	<0.01	70.2 (63.7,76.4)	68.8 (62.0,74.9)	70.3 (63.3,76.6)	35.5	<0.01
Physical activity	8 608 (27.8)	947 (30.8)	610 (28.2)	12.5	<0.01	1 062 (24.7)	610 (28.4)	606 (28.2)	14.2	<0.01
Disease history and family history										
Hypertension	9 021 (29.1)	1 857 (60.4)	1 068 (49.4)	1 517.7	<0.01	1 589 (36.9)	1 278 (59.4)	1 066 (49.5)	308.9	<0.01
Cardiovascular disease	1 688 (5.5)	346 (11.3)	158 (7.3)	172.0	<0.01	302 (7.0)	244 (11.3)	158 (7.3)	38.4	<0.01
Family history of T2DM	2 982 (9.6)	884 (28.7)	295 (13.6)	1 016.2	<0.01	354 (8.2)	619 (28.8)	292 (13.6)	485.7	<0.01



(续表 1)

Characteristics	Before PSM					After PSM				
	Healthy subjects (n=30 988)	Previously diagnosed T2DM (n=3 076)	Screened T2DM (n=2 162)	$\chi^2/H$	<i>P</i>	Healthy subjects (n=4 304)	Previously diagnosed T2DM (n=2 152)	Screened T2DM (n=2 152)	$\chi^2/H$	<i>P</i>
Physical measurements and biochemical indicators										
BMI (kg/m <sup>2</sup> )	24.0 (21.9,26.2)	25.4 (23.4,27.6)	25.9 (23.9,28.2)	1 078.0	<0.01	24.2 (22.3,26.4)	25.4 (23.4,27.8)	25.9 (23.9,28.2)	403.5	<0.01
WC (cm)	81.0 (74.3,87.3)	85.3 (80.0,91.0)	86.0 (80.3,92.0)	1 182.9	<0.01	82.5 (76.5,88.7)	85.7 (80.0,91.7)	86.0 (80.3,92.0)	311.0	<0.01
FPG (mmol/L)	4.6 (4.2,5.1)	6.8 (5.5,8.6)	6.5 (5.4,7.6)	6 967.8	<0.01	4.6 (4.2,5.0)	6.6 (5.3,8.3)	6.5 (5.4,7.6)	3 343.1	<0.01
HbA1c (%)	5.6 (5.3,5.8)	7.0 (6.3,8.0)	6.8 (6.5,7.3)	10 612.3	<0.01	5.6 (5.3,5.8)	6.9 (6.3,8.0)	6.8 (6.5,7.3)	5 099.0	<0.01
TG (mmol/L)	1.3 (1.0,1.9)	1.5 (1.1,2.2)	1.8 (1.3,2.5)	735.2	<0.01	1.4 (1.0,1.9)	1.5 (1.1,2.2)	1.8 (1.3,2.5)	319.4	<0.01
LDLC (mmol/L)	2.7 (2.2,3.3)	2.7 (2.1,3.3)	2.9 (2.4,3.5)	98.2	<0.01	2.8 (2.3,3.3)	2.7 (2.1,3.2)	2.9 (2.4,3.5)	88.4	<0.01
HDLC (mmol/L)	1.4 (1.2,1.6)	1.3 (1.1,1.5)	1.3 (1.1,1.5)	458.0	<0.01	1.4 (1.2,1.6)	1.3 (1.1,1.5)	1.3 (1.1,1.5)	208.1	<0.01

PSM applied to control sex and age.

**3 组人群体力活动情况比较** 按性别展示 3 组人群的体力活动情况(表 2),各类体力活动均未见显著的性别差异(异质性检验, $P>0.05$ ),仅家务活动存在一定的性别差异(异质性检验, $P=0.07$ )。男性中,3 组人群的静态行为差异有统计学意义( $P=0.04$ ),既往确诊组静坐时间最长,调整年龄、文化程度和糖尿病家族史后平均时长达 273 min/天(95%CI: 262~283),但其他类型的体力活动参与率、活动量差异均无统计学意义。女性中,3 组人群的体力活动情况因活动类型不同而异。体育运动参与率及活动量差异有统计学意义( $P<0.01$ ),筛检确诊组剧烈运动参与率及运动量最高,分别为 7.6%和 220 MET-min/周(95%CI: 173~266),既往确诊组次之,分别为 5.8%和 152 MET-min/周(95%CI: 105~200)。既往确诊组中等强度体育运动参与率最高,达 23.7%,平均运动量达 373 MET-min/周(95%CI: 328~417),筛检确诊组次之,参与率 23.2%,平均运动量 357 MET-min/周(95%CI: 314~401)。既往确诊组中自行车作为交通方式的比例( $P<0.01$ )及活动量最低( $P=0.02$ ),而步行交通方式的活动量较高( $P=0.04$ ),家务劳动参与率( $P<0.01$ )及活动量最低( $P=0.04$ ),静态行为时间

最长( $P<0.01$ )。

**不同年龄、文化程度 3 组人群体育活动参与率比较** 女性筛检确诊患者剧烈运动参与率显著高于对照组(表 3),而既往确诊患者的中等强度运动较高,OR (95%CI) 分别为 1.5 (1.1~2.0) 和 1.2(1.0~1.4)。

进一步按年龄组和文化程度分层比较 3 组人群中中等强度运动的参与率。无论年龄和文化程度,男性 3 组人群中中等强度体育活动参与率差异均无统计学意义;女性中,55 岁以下和初中文化程度既往确诊组的参与率显著高于血糖正常组,调整可能的混杂因素后 OR (95%CI) 分别为 1.5 (1.0~2.1) 和 1.5(1.1~2.1)。

剧烈运动方面,男性中存在显著的年龄异质性( $P<0.01$ ),55 岁以下既往确诊组及 65~74 岁既往确诊组和筛检确诊组的参与率较高,分别为 16.5%、11.5% 和 10.3%,显著高于相应的血糖正常组,OR (95%CI)分别为 2.4(1.5~3.8)、1.9 (1.6~3.0)和 1.6 (1.0~2.6);女性中仅 65~74 岁和小学及以下筛检确诊组的参与率显著高于血糖正常组,OR (95%CI)分别为 1.7(1.1~2.7)和 1.7 (1.2~2.4),但交互作用检验  $P$  值均  $>0.05$ 。

表2 PSM后3组人群的体力活动比较

Tab 2 Comparisons of physical activities in the 3 groups after PSM

Physical activities	Men					Women					<i>P</i> for heterogeneity by sex	
	Healthy subjects ( <i>n</i> =1 834)	Previously diagnosed T2DM ( <i>n</i> =917)	Screened T2DM ( <i>n</i> =917)	$\chi^2/F$	<i>P</i>	Healthy subjects ( <i>n</i> =2 470)	Previously diagnosed T2DM ( <i>n</i> =1 235)	Screened T2DM ( <i>n</i> =1 235)	$\chi^2/F$	<i>P</i>		
Participation rate [ <i>n</i> ( % )]												
Exercise	460 (25.1)	264 (28.8)	250 (27.3)	4.6	0.09	602 (24.4)	346 (28.0) <sup>(1)</sup>	356 (28.8) <sup>(1)</sup>	10.6	< <b>0.01</b>	0.59	
Vigorous	156 (8.5)	100 (10.9)	95 (10.4)	4.9	0.08	128 (5.2)	71 (5.8)	94 (7.6) <sup>(1)</sup>	8.8	<b>0.01</b>	0.27	
Moderate	339 (18.5)	183 (20.0)	177 (19.3)	0.9	0.64	503 (20.4)	293 (23.7)	286 (23.2)	7.0	<b>0.03</b>	0.62	
Commute	430 (23.4)	222 (24.2)	236 (25.7)	1.7	0.41	840 (34.0)	426 (34.5)	451 (36.5)	2.3	0.31	0.98	
Bicycle	169 (9.2)	65 (7.1)	90 (9.8)	4.9	0.09	268 (10.9)	94 (7.6) <sup>(1)</sup>	127 (10.3)	10.0	< <b>0.01</b>	0.73	
Walking	331 (18.1)	178 (19.4)	192 (20.9)	3.4	0.19	648 (26.2)	361 (29.2)	363 (29.4)	5.8	0.05	0.83	
Housework	1 417 (77.3)	677 (73.8)	708 (77.2)	4.5	0.11	2 386 (96.6)	1 163 (94.2) <sup>(1)</sup>	1 175 (95.1)	12.5	< <b>0.01</b>	0.07	
Intensity of physical activity [ls-mean (95%CI)]												
Total (MET-min/wk)	2 304 (2 215–2 394)	2 322 (2 194–2 450)	2 427 (2 301–2 553)	1.3	0.28	3 477 (3 402–3 552)	3 436 (3 328–3 543)	3 590 (3 485–3 695)	2.3	0.10	0.86	
Exercise	514 (456–573)	622 (538–706)	587 (505–669)	2.4	0.10	450 (404–496)	525 (460–591)	577 (513–641) <sup>(1)</sup>	5.3	< <b>0.01</b>	0.42	
Vigorous	240 (191–289)	319 (249–389)	279 (210–347)	1.6	0.20	144 (111–177)	152 (105–200)	220 (173–266) <sup>(1)</sup>	3.6	<b>0.03</b>	0.16	
Moderate	274 (240–308)	303 (255–352)	308 (261–356)	0.9	0.43	306 (274–337)	373 (328–417) <sup>(1)</sup>	357 (314–401)	3.5	<b>0.03</b>	0.85	
Commute	335 (299–371)	319 (267–370)	389 (338–440)	2.1	0.12	439 (405–472)	419 (372–467)	487 (441–534)	2.2	0.11	0.99	
Bicycle	110 (91–130)	75 (47–103)	113 (85–140)	2.4	0.09	118 (101–134)	74 (50–98) <sup>(1)</sup>	104 (81–128)	4.2	<b>0.02</b>	0.74	
Walking	225 (196–254)	244 (202–285)	277 (236–317)	2.1	0.12	321 (292–350)	345 (304–386)	383 (343–423) <sup>(1)</sup>	3.1	<b>0.04</b>	0.94	
Housework	1 455 (1 399–1 511)	1 382 (1 301–1 462)	1 451 (1 372–1 530)	1.1	0.32	2 588 (2 543–2 634)	2 491 (2 427–2 556)	2 526 (2 462–2 589)	3.2	<b>0.04</b>	0.69	
Sedentary behavior (min/d)	261 (254–268)	273 (262–283) <sup>(1)</sup>	255 (245–265) <sup>(2)</sup>	3.0	<b>0.04</b>	225 (220–231)	235 (227–243)	216 (209–224) <sup>(1)(2)</sup>	5.7	< <b>0.01</b>	0.74	
Physical activity level [ <i>n</i> ( % )]												
High	548 (29.9)	283 (30.9)	298 (32.5)	2.4	0.66	1 460 (59.1)	724 (58.6)	739 (59.8)	4.6	0.33	0.63	
Medium	876 (47.8)	424 (46.2)	424 (46.2)			897 (36.3)	442 (35.8)	423 (34.2)				
Low	410 (22.4)	210 (22.9)	195 (21.3)			113 (4.6)	69 (5.6)	73 (5.9)				

<sup>a</sup> Ls-mean adjusted for age, educational level and family history of T2DM. <sup>(1)</sup> vs. Healthy subjects; <sup>(2)</sup> vs. Previously diagnosed T2DM patients.

表3 不同年龄和文化程度3组人群体育运动参与率比较

Tab 3 Participation rates of vigorous and moderate exercises across 3 groups by age group and educational level

Stratified index	Vigorous exercise							Moderate exercise						
	Participation rate [ <i>n</i> (%) ]			<i>P</i>	OR (95%CI) <sup>a</sup>		<i>P</i> for interaction	Participation rate [ <i>n</i> (%) ]			<i>P</i> value	OR (95%CI) <sup>a</sup>		<i>P</i> for interaction
	Healthy subjects	Previously diagnosed T2DM	Screened T2DM		Previously diagnosed T2DM	Screened T2DM		Healthy subjects	Previously diagnosed T2DM	Screened T2DM		Previously diagnosed T2DM	Screened T2DM	
All participants	284 (6.6)	171 (8.0)	189 (8.8)	<b>&lt;0.01</b>	1.2 (1.0–1.5)	1.4 (1.1–1.7)		842 (19.6)	476 (22.1)	463 (21.5)	<b>0.03</b>	1.1 (0.9–1.3)	1.1 (0.9–1.3)	
Men	156 (8.5)	100 (10.9)	95 (10.4)	0.08	1.3 (0.9–1.7)	1.2 (0.9–1.6)	0.27	339 (18.5)	183 (20.0)	177 (19.3)	0.64	1.1 (0.9–1.3)	1.0 (0.9–1.3)	0.62
Women	128 (5.2)	71 (5.8)	94 (7.6)	<b>0.01</b>	1.1 (0.8–1.5)	1.5 (1.1–2.0)		503 (20.4)	293 (23.7)	286 (23.2)	<b>0.03</b>	1.2 (1.0–1.4)	1.2 (0.9–1.4)	
Age (y)														
Men														
<55	41 (8.5)	40 (16.5)	27 (11.2)	<b>0.01</b>	2.4 (1.5–3.8)	1.4 (0.9–2.4)	<b>&lt;0.01</b>	78 (16.1)	39 (16.1)	35 (14.5)	0.83	1.0 (0.7–1.6)	0.9 (0.6–1.4)	0.38
55–64	72 (10.5)	22 (6.4)	34 (9.9)	0.10	0.5 (0.3–0.8)	0.9 (0.6–1.4)		154 (22.4)	76 (22.1)	73 (21.2)	0.91	1.0 (0.7–1.4)	0.9 (0.7–1.3)	
65–74	43 (6.5)	38 (11.5)	34 (10.3)	<b>0.02</b>	1.9 (1.6–3.0)	1.6 (1.0–2.6)		107 (16.2)	68 (20.5)	69 (20.9)	0.10	1.2 (0.9–1.7)	1.4 (0.9–1.9)	
Women														
<55	30 (5.5)	20 (7.3)	18 (6.6)	0.57	1.4 (0.8–2.6)	1.3 (0.7–2.4)	0.46	111 (20.3)	66 (24.1)	66 (24.1)	0.31	1.5 (1.0–2.1)	1.4 (0.9–2.0)	0.76
55–64	54 (5.4)	32 (6.3)	39 (7.7)	0.19	1.1 (0.7–1.8)	1.5 (0.9–2.2)		249 (24.7)	137 (27.1)	129 (25.5)	0.58	1.0 (0.8–1.4)	1.0 (0.8–1.3)	
65–74	44 (4.8)	19 (4.2)	37 (8.1)	<b>0.02</b>	0.9 (0.5–1.5)	1.7 (1.1–2.7)		143 (15.7)	90 (19.7)	91 (20.0)	0.07	1.3 (0.9–1.8)	1.3 (0.9–1.7)	
Educational level														
Men														
Primary school or below	54 (6.7)	38 (9.6)	33 (8.1)	0.20	1.5 (0.9–2.4)	1.2 (0.8–1.9)	0.78	129 (16.1)	81 (20.6)	73 (17.9)	0.16	1.3 (0.9–1.8)	1.2 (0.8–1.6)	0.41
Junior high school	66 (8.8)	41 (10.6)	44 (12.0)	0.23	1.2 (0.8–1.9)	1.4 (0.9–2.2)		132 (17.6)	71 (18.3)	68 (18.5)	0.92	1.0 (0.7–1.4)	1.0 (0.8–1.5)	
Senior high school or above	36 (12.8)	21 (15.6)	18 (12.6)	0.70	1.2 (0.7–2.2)	1.0 (0.5–1.8)		78 (27.7)	31 (23.0)	36 (25.2)	0.58	0.8 (0.5–1.3)	0.9 (0.6–1.4)	
Women														
Primary school or below	75 (4.5)	45 (5.2)	66 (7.9)	<b>&lt;0.01</b>	1.0 (0.7–1.6)	1.7 (1.2–2.4)	0.43	305 (18.3)	190 (22.1)	184 (21.9)	0.03	1.2 (0.9–1.5)	1.2 (0.9–1.5)	0.11
Junior high school	37 (6.0)	17 (5.7)	22 (6.9)	0.81	1.0 (0.6–1.9)	1.2 (0.7–2.2)		133 (21.4)	84 (28.3)	80 (25.0)	0.07	1.5 (1.1–2.1)	1.3 (0.9–1.7)	
Senior high school or above	16 (8.6)	9 (11.7)	6 (7.9)	0.67	1.7 (0.7–4.2)	1.0 (0.4–2.8)		65 (35.0)	19 (24.7)	22 (29.0)	0.23	0.6 (0.3–1.2)	0.7 (0.4–1.3)	

<sup>a</sup> OR (95%CI) using the healthy subjects as the reference group, and adjusted for age, educational level, prevalent hypertension, diagnosis of cardiovascular disease and family history of T2DM.

## 讨 论

本研究基于一项大样本队列研究的基线调查数据,从不同类型的体力活动参与率、体力活动量和活动水平分级多方面,较为系统地分析和比较了上海社区 T2DM 既往确诊者、筛检确诊者和血糖正常者的体力活动情况。结果显示,研究人群 T2DM 粗患病率为 14.5%,标化患病率为 10.5%,略低于全国平均水平<sup>[1]</sup>;T2DM 知晓率为 58.7%,略高于全国平均水平<sup>[1]</sup>;不同性别 3 组人群总体力活动、活动量及活动水平分级差异均无统计学意义,但既往确诊患者的静态行为时间最长;男性中 3 组人群各类体力活动的参与率及活动量整体上差异无统计学意义,而女性中,筛检确诊患者剧烈运动的参与率较高,既往确诊者中等强度运动的参与率较高。

本次研究中 3 组人群总体力活动差异无统计学意义。一方面,筛检确诊者总体力活动与血糖正常者差异无统计学意义,未提示总体力活动量是该人群发生 T2DM 的主要危险因素。大量流行病学调查显示,体力活动不足与中国人 T2DM 的发生有显著关联,但对 T2DM 的归因危险度 (population attributable risk, PAR) 仅为 1.7%~3.6%,远低于超重 (PAR: 41.5%~48.6%) 和肥胖 (PAR: 30.3%~50.4%) 等主要危险因素<sup>[22]</sup>。另一方面,既往确诊患者的总体力活动水平并不高于筛检患者,该结果与 Zhang 等<sup>[13]</sup>的发现一致,但与 Ding 等<sup>[15]</sup>发现的既往确诊患者体力活动水平较血糖正常人群低的结论不同。根据人类的行为心理学模式, T2DM 患者获知疾病风险后会加强自我管理<sup>[23]</sup>,改善行为生活方式<sup>[10]</sup>,尽可能降低疾病危害。然而,既往研究和本研究均未发现 T2DM 现患者的总体力活动高于筛检患者,一方面可能是不同类型体力活动的变化存在差异而导致总体力活动量无变化,另一方面,现患病例中达到每周至少 150 min 中等强度运动及等量的高强度运动的达标率仅为 25.2%,远低于南亚和欧洲等地区的水平<sup>[24-25]</sup>。该结果提示 T2DM 现患病例可能并不知晓体力活动对血糖控制的重要性,因而未积极采取有效的非药物治疗方法。

本研究还发现,既往确诊和筛检 T2DM 患者及血糖正常者不同类型体力活动的参与率及活动量有一定差异,并表现出性别差异。男性中 3 组人群

各类体力活动的参与率及活动量差异无统计学意义;女性中,筛检确诊患者剧烈运动的参与率较高,既往确诊患者中等强度运动的参与率较高。该结果与既往大量研究结果一致,提示中国女性较男性更倾向于采取健康生活方式,对疾病管理更积极<sup>[26]</sup>。值得注意的是,女性筛检确诊患者有较高的剧烈运动参与率及活动量,该结果不符合 T2DM 的病因学假设,可能这些女性知晓其血糖水平已达糖尿病前期,有意识地进行高强度体力活动。Okosun 等<sup>[27]</sup>也发现,糖尿病前期患者知晓患病风险后会控制体重、增加体力活动、降低热量摄入。相比之下,女性既往确诊患者的中等强度体育活动参与率较高,但活动量并无明显改善,提示虽然该人群增强了运动意识,提高了运动参与率,但对所需达到的运动量并不了解,未显著提高各类体力活动的量。需要加强患者的健康教育,提高其健康素养,引导其科学运动。

按年龄和文化程度进行分层分析的结果显示, <55 岁和 65~74 岁男性既往确诊患者及 65~74 岁组男性筛检确诊患者剧烈运动参与率显著高于血糖正常者;65~74 岁及文化程度较低的女性筛检确诊患者剧烈运动的参与率较高;<55 岁及初中文化程度女性既往确诊患者中等强度运动的参与率较高。这些结果提示,不同性别和年龄的既往确诊患者和筛检确诊患者在运动方式选择上存在较大差异,进一步证实了体力活动的性别和年龄特异性,也提示在进行健康教育和运动干预时,需考虑患者的年龄和性别差异,推荐个性化运动方式有利于患者长期坚持。

本研究的优势在于基于大样本数据进行分析,采用 PSM 方法控制混杂因素,较为全面地评估和比较了 3 组人群不同类型体力活动的参与率、运动量及活动水平,真实描述了 T2DM 确诊状况不同人群的体力活动情况。然而,本研究为横断面研究设计,不能建立 T2DM 糖尿病确诊状态与体力活动情况之间的因果关联。此外,本研究中既往 T2DM 的诊断遵循中国糖尿病诊疗指南,依据 WHO1999 年标准,而筛检患者由于未进行口服糖耐量试验而依据空腹血糖和 HbA1c 检测水平,参考 ADA 的部分标准进行诊断,可能存在一定的错分偏倚。

目前我国 T2DM 知晓率仅为 43.3%<sup>[1]</sup>,本研究中人群知晓率也仅为 58.7%。大量未确诊患者未及



时获得药物和非药物治疗及干预,以致发生大血管和微血管并发症的风险较高<sup>[28]</sup>。即使是确诊患者,其体力活动参与率及活动量也远未达到推荐水平,急需采取有效措施。本研究结果提示,为降低T2DM及其并发症带来的巨大疾病负担,需加强T2DM筛查,提高知晓率,实现早期诊断及药物和非药物治疗;对T2DM确诊患者,运动治疗尚存在较大的提升空间,可以作为对患者进行健康教育和健康管理的重要内容。

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**利益冲突声明** 所有作者均声明不存在利益冲突。

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