Published in final edited form as:

Diabetes Obes Metab. 2019 January ; 21(1): 170–172. doi:10.1111/dom.13475.

Dyslipidaemia and statin use in individuals aged 10 to <40 years in the T1D Exchange clinic registry

Sarah K. Lyons, MD¹, Claire T. Boyle, MS², Daniel J. DeSalvo, MD¹, Michael R. Rickels, MD³, Lauren K. Wood Heckman, MD⁴, Kellee M. Miller, PhD², Nicole C. Foster, MS², Mark A. Clements, MD⁵ T1D Exchange Clinic Network

¹Baylor College of Medicine, Pediatric Diabetes and Endocrinology, Houston, Texas

²Jaeb Center for Health Research, Tampa, Florida

³University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania

⁴University of Virginia School of Medicine, Pediatric Endocrinology and Diabetes, Charlottesville, Virginia

⁵Children's Mercy Hospital, Kansas City, Missouri

Abstract

For individuals aged 10 to <40 years with type 1 diabetes and dyslipidaemia, US national guidelines recommend consideration of statin therapy based on age, low-density lipoprotein cholesterol (LDL-C) level and other cardiovascular risk factors. We evaluated dyslipidaemia prevalence, statin therapy use, and associations between not meeting target LDL-C [<100 mg/dL (<5.55 mmol/L)] and other cardiovascular disease (CVD) risk factors in individuals aged 10 to <40 years in the T1D Exchange clinic registry. In 7223 participants, statin use was 2% in 10 to <18 year olds, 4% in 18 to <25 year olds, and 21% in 25 to <40 year olds. Individuals not on statin therapy with LDL-C above target were more likely to have 1 additional CVD risk factor(s) than those with LDL-C in the target range for all age groups (all $P < 0.01$). While most individuals not on statin therapy had LDL-C in the target range, those who did not were more likely to have 1 additional CVD risk factor(s), and therefore longitudinal study of lipid levels and statin use is needed to see if treatment of dyslipidaemia to target LDL-C levels may lower the risk of future CVD in individuals aged 10 to <40 years with type 1 diabetes.

Keywords

dyslipidaemia; type 1 diabetes

Correspondence: Claire Boyle, MS, Jaeb Center for Health Research, 15310 Amberly Drive, Suite 350, Tampa, FL 33647. t1dstats6@jaeb.org.

AUTHOR CONTRIBUTIONS

S. K. L. and C. T. B. researched data, performed statistical analyses, and wrote/edited the manuscript. M. R. R., K. M. M., N. C. F. and M. A. C. researched data and reviewed/edited the manuscript. K. M. M. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis.

Conflict of interest

The authors have no financial disclosures.

1 | INTRODUCTION

Type 1 diabetes and dyslipidaemia are both risk factors for cardiovascular disease (CVD). For clinicians caring for individuals aged 10 to <40 years with type 1 diabetes (T1D) and dyslipidaemia, national guidelines recommend starting with lifestyle modification and then, depending on an individual's age and the severity of CVD risk based on low-density lipoprotein cholesterol (LDL-C) level and other risk factors, consideration of statin pharmacotherapy.^{1–4} The T1D Exchange clinic registry is comprised of >30 000 individuals in the United States with T1D and provides a rich data set to evaluate dyslipidaemia prevalence, statin therapy use, and associations between not meeting target LDL-C [<100 mg/dL (5.55 mmol/L)] and other CVD risk factors in individuals aged 10 to <40 years with T1D.⁵ We hypothesized that individuals aged 10 to <40 years in the T1D Exchange not meeting the LDL-C target were more likely to have additional modifiable CVD risk factors.

2 | METHODS

Non-pregnant registry participants from 78 sites across the United States with clinical data updated <15 months prior, age 10 to <40 years, diabetes duration ≥ 1 year, and no CVD history, were included. Participant characteristics, last available lipid levels, statin medication use (defined by clinic-reported use), and modifiable CVD risk factors of smoking, hypertension and elevated body mass index (BMI) were extracted from medical records.⁵ Chi-square and t-tests (or non-parametric equivalents where appropriate) were used to compare characteristics between statin users and non-users, and to assess associations between not meeting target LDL-C and CVD risk factors versus not meeting risk factors among statin non-users. Analyses were stratified by age group (paediatric: 10–<18 years, young adult: 18–<25 years, and adult: 25–<40 years). Because of multiple comparisons, only *P*-values <0.01 were considered statistically significant.

3 | RESULTS

The analysis cohort included 7223 participants (53% ages 10–<18, 28% ages 18–<25, and 19% ages 25–<40 years) with mean age 20 ± 7 years, diabetes duration 11 ± 6 years, 79% non-Hispanic White, and 50% female. Mean total cholesterol, LDL-C, high-density lipoprotein cholesterol (HDL-C) and triglycerides (TG) were similar across age groups (Table 1).

Statin use in the 10 to <18 years group was 2%, 4% in the 18 to <25 years group, and 21% in the 25 to <40 years group. Statin users in the 10 to <18 years group were older with longer T1D duration, lower annual household income, and higher BMI (Table 2; all *P* < 0.01). Statin users in the 18 to <25 years group were more likely to have longer diabetes duration and lower annual household income (both *P* < 0.01). Statin users in the 25 to <40 years group were more likely to be older and male, and to have longer type 1 diabetes duration, higher BMI, and hypertension (all *P* < 0.01).

Mean LDL-C was higher among statin users than non-users across all age groups [10–<18 years group: 129 ± 35 vs. 91 ± 29 (7.16 ± 1.94 mmol/L vs. 5.05 ± 1.61 mmol/L); 18–<25 years group: 126 ± 43 vs. 96 ± 31 (6.99 ± 2.39 mmol/L vs. 5.33 ± 1.72 mmol/L); 25–<40

years group: 104 ± 35 vs. 95 ± 28 (5.77 ± 1.9 mmol/L vs. 5.27 ± 1.55 mmol/L); all $P < 0.01$). A majority of those not on statin therapy in each age group met the target LDL-C < 100 mg/dL (< 5.55 mmol/L), while fewer statin users met the target LDL-C < 100 mg/dL (< 5.55 mmol/L) (Table 2; $P < 0.01$). Among statin non-users, those with LDL-C > 100 mg/dL (> 5.55 mmol/L) were more likely to have ≥ 1 additional CVD risk factor(s) (smoking, hypertension, obesity, HDL-C < 40 mg/dL (< 2.22 mmol/L), and HbA1c above ADA target $< 7.5\%$ for < 18 years and $< 7.0\%$ for ≥ 18 years) than those with LDL-C < 100 mg/dL (< 5.55 mmol/L) for all age groups (all $P < 0.01$).

4 | DISCUSSION

Treatment of type 1 diabetes includes management of risk factors for CVD including dyslipidaemia, and national guidelines for individuals aged 10 to < 40 years with T1D recommend consideration of statin therapy based on an individual's LDL-C level and other CVD risk factors. Our T1D Exchange registry data allow a cross-sectional view of lipid levels and statin therapy use in a large cohort of individuals with T1D in the United States. While the majority of those not on statin therapy met the recommended target LDL-C < 100 mg/dL (< 5.55 mmol/L), those who did not were more likely to have ≥ 1 additional CVD risk factor(s). Furthermore, only 25% of those aged < 25 years and 50% of those aged 25 to < 40 years prescribed a statin met target LDL-C. Notably, these data are cross-sectional, do not consider variable adherence to statin therapy, and for those prescribed statin therapy, the last available levels may not have been measured during ongoing statin therapy. As scant clinical trial evidence exists to support national guidelines recommendations for statin pharmacotherapy in individuals aged < 40 years with T1D, longitudinal evaluation of lipid levels and statin use is needed to assess whether more aggressive treatment of dyslipidaemia to target LDL-C levels may lower the risk of future CVD.

Acknowledgments

Funding information

Funding was provided by the Leona M. and Harry B. Helmsley Charitable Trust.

REFERENCES

1. American Diabetes Association. 12. Children and adolescents: standards of medical care in diabetes-2018. *Diabetes Care*. 2018;41: S126–S136. [PubMed: 29222383]
2. American Diabetes Association. 9. Cardiovascular disease and risk management: standards of medical care in diabetes-2018. *Diabetes Care*. 2018;41:S86–S104. [PubMed: 29222380]
3. de Ferranti SD, de Boer IH, Fonseca V, et al. Type 1 diabetes mellitus and cardiovascular disease: a scientific statement from the American Heart Association and American Diabetes Association. *Circulation*. 2014;130:1110–1130. [PubMed: 25114208]
4. Expert Panel on Integrated Guidelines for Cardiovascular Health, Risk Reduction in Children, Adolescents, National Heart Lung, and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. *Pediatrics*. 2011;128(Suppl 5):S213–S256. [PubMed: 22084329]
5. Beck RW, Tamborlane WV, Bergenstal RM, Miller KM, Dubose SN, Hall CA. The T1D Exchange clinic registry. *J Clin Endocrinol Metab*. 2012;97:4383–4389. [PubMed: 22996145]

Table 1

Participant lipid levels by age range

	Age 10 to <18 y N = 3863	Age 18 to <25 y N = 2018	Age 25 to <40 y N = 1342
Total cholesterol in mg/dL (mmol/L)			
Mean ± SD	168 ± 36 (9.32 ± 1.99)	174 ± 38 (9.66 ± 2.11)	177 ± 34 (9.82 ± 1.89)
LDL-C in mg/dL (mmol/L)			
Median (IQR)	88 (71, 107) [4.88 (3.94, 5.94)]	94 (74, 114) [5.23, (4.12, 6.33)]	95 (76, 114) [5.27 (4.23, 6.33)]
100 mg/dL (5.55 mmol/L) (%)	34	43	43
HDL-C in mg/dL (mmol/L)			
Mean ± SD	57 ± 14 (3.16 ± 0.78)	56 ± 15 (3.11 ± 0.83)	62 ± 17 (3.44 ± 0.94)
<40 mg/dL (<2.22 mmol/L) (%)	8	10	8
TG in mg/dL (mmol/L)			
Median (IQR)	86 (62, 126) [86 (3.44, 6.99)]	87 (63, 130) [4.83 (3.50, 7.22)]	77 (57, 117) [4.27 (3.16, 6.49)]
150 mg/dL (8.33 mmol/L) (%)	17	18	14

Table 2

Comparing participant characteristics between statin users and non-users

	Ages 10 to <18 y			Ages 18 to <25 y			Ages 25 to <40 y		
	Statin users (n = 61)	Statin non-users (n = 3802)	P-value	Statin users (n = 83)	Statin non-users (n = 1935)	P-value	Statin users (n = 285)	Statin non-users (n = 1057)	P-value
Age (y) (mean ± SD)	15 ± 2	14 ± 2	<0.001	21 ± 2	20 ± 2	0.03	34 ± 4	31 ± 4	<0.001
Female	57%	48%	0.15	60%	50%	0.07	39%	58%	<0.001
Non-Hispanic white	66%	77%	0.03	74%	80%	0.24	87%	87%	0.95
T1D duration (y)	9 ± 3	8 ± 4	0.002	13 ± 5	11 ± 5	0.002	21 ± 8	19 ± 8	<0.001
Annual household income US\$75000	29%	51%	<0.001	39%	57%	0.001	40%	43%	0.85
Smoker	0%	<1%	<i>a</i>	2%	4%	<i>a</i>	7%	7%	0.72
BMI									
Mean ± SD z-score	1.3 ± 0.8	0.8 ± 0.9	<0.001	0.6 ± 1.1	0.3 ± 1.0	0.01	0.4 ± 0.9	0.0 ± 0.8	<0.001
Overweight/obese (%)	71	41		62	48		83	64	
Hypertension (%)	<i>a</i>	<1	<i>a</i>	13	4	<i>a</i>	38	15	<0.001
Frequency of SMBG per day	4 ± 2	4 ± 2	0.07	3 ± 2	4 ± 2	0.02	4 ± 2	4 ± 3	0.79
CGM use	13%	24%	0.05	22%	23%	0.93	39%	36%	0.51
Pump use	52%	64%	0.04	57%	62%	0.29	67%	68%	0.83
LDL-C in mg/dL (mmol/L)									
Mean ± SD	129 ± 35 (7.16 ± 1.94)	91 ± 29 (5.05 ± 1.61)	<0.001	126 ± 43 (6.99 ± 2.39)	96 ± 31 (5.33 ± 1.72)	<0.001	104 ± 35 (5.77 ± 1.94)	95 ± 28 (5.27 ± 1.55)	<0.001
LDL-C < 100 mg/dL (<5.55 mmol/L) (%)	25	67		26	59		51	58	
1 DKA event in prior year ^b (%)	12	6	<i>a</i>	11	5	<i>a</i>	4	2	<i>a</i>
HbA1c									
Mean ± SD	10.1 ± 1.9	9.0 ± 1.8	0.06 ^c	9.5 ± 1.8	8.9 ± 1.9	0.1 ^c	8.0 ± 1.4	7.8 ± 1.5	0.43 ^c
Meeting ADA target ^d (%)	7	15		2	11		18	29	

Abbreviations: SMBG, self-monitoring of blood glucose; CGM, continuous glucose monitor; LDL, low-density lipoprotein cholesterol.

^aToo few observations to perform statistical analysis.^bDefined as having hyperglycaemia meeting the following criteria: (1) symptoms such as polyuria, polydipsia, nausea, or vomiting; (2) serum ketones or large/moderate urine ketones; (3) either arterial blood pH <7.30 or venous pH <7.30 or serum bicarbonate <15; and (4) treatment provided in a healthcare facility.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Adjusted for age, T1D duration, sex, annual household income, race/ethnicity, frequency of blood glucose checks per day, smoking status, hypertension, and BMI in a linear regression model.
 $p < 7.5\%$ for age < 18 y and $< 7.0\%$ for age ≥ 18 y.