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BRIEF REPORT

The Association of Patient Age with Cardiovascular Disease Risk Factor Treatment and Control in Diabetes

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BACKGROUND: While inadequate treatment intensification may contribute to sub-optimal CVD risk factor control in older patients with diabetes, the relationship between patient age and treatment intensification is largely unexplored.

OBJECTIVE: To examine differences in treatment intensification and control for blood pressure (BP), lipids and A1c in older vs. younger adults with diabetes.

METHODS: A total of 161,697 Kaiser Permanente Northern California adult diabetes patients were stratified by age (<50, 50–64, 65–74 and 75–85) and assessed for control of A1c (<8%), LDL-c (<100 mg/dl) and SBP (<140 mmHg). Probit models assessed the marginal effects of patient age on treatment intensification and control for all three CVD risk factors.

RESULTS: Patients aged 50–64 and 65–74 were significantly more likely to receive treatment intensification for elevated SBP than patients under 50 (74% and 76% vs. 71%) and significantly less likely to receive treatment intensification for elevated A1c (73% and 72% vs. 76%), with no differences noted for LDL-c treatment. Older patients had significantly worse SBP control, but better control of A1c and LDL-c.

CONCLUSIONS: Both treatment intensification rates and control of BP, A1c and LDL cholesterol control varied somewhat by age, suggesting room for further improvement in treatment intensification and control.

KEY WORDS: older adults; diabetes mellitus; cardiovascular disease; adherence; treatment intensification; hypertension; hyperlipidemia.
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INTRODUCTION

Control and treatment of cardiovascular disease (CVD) risk factors in diabetes, especially blood pressure (BP) and lipids, significantly reduces morbidity and mortality.[1–3] CVD risk factor control is of particular importance in older adults; studies have shown that treatment of high BP in particular resulted in a significant decrease in heart disease and mortality in older age groups.[4,5]

The effect of age on CVD risk factor control is variable. While older adults have better glycemic control[6] and LDL control[7] than younger patients, they have worse BP control.[8]

One central reason that patients fail to achieve target CVD risk factor control is lack of timely treatment intensification, or the modification of drug therapy in response to elevated CVD risk factor levels, by the provider.[9,10] There are many potential barriers to treatment intensification in older patients with diabetes, including decreased functional status, polypharmacy, shorter life expectancy and controversy regarding optimal risk factor control levels in older adults.[11,12] However, little is known about whether age is independently associated with the likelihood of receiving treatment intensification in adults with diabetes.[13] The purpose of this study is to examine differences in CVD treatment intensification and risk factor control in older vs. younger patients with diabetes.

METHODS

We conducted this study in one of six centers of Translating Research into Action for Diabetes (TRIAD) at Kaiser Permanente Northern California (KP). KP is an integrated health-care delivery system providing comprehensive medical care to approximately 3.2 million members in Northern California. We selected study participants from the KP diabetes registry if they had diabetes prior to January 1, 2005, were between ages 18 and 85, and were continuously enrolled with an active medication benefit during all of 2004 and 2005. We then assessed participants for clinically recognized hypertension and hyperlipidemia prior to January 1, 2005 using KP automated clinical databases.[9]

Definitions of Target Levels for Risk Factor Control. For each CVD risk factor separately, we defined being above target as: two

consecutive SBP readings of ≥140 mmHg for hypertension patients; LDL-c value ≥100 mg/dl for hyperlipidemia patients; A1c lab value ≥8.0%; all these at any point during 2005.

Treatment Intensification. We assessed treatment intensification for each CVD risk factor separately using KP prescription databases for the 3 months before and the 3 months following first measurement of above target levels (for SBP, we used the date of the second reading). We denoted that intensification occurred if there was (1) an increase in the number of drug classes being prescribed, (2) an increase in the daily dosage of at least one ongoing drug class or (3) a switch to a medication in a different drug class.

For both medication adherence and treatment intensification in diabetes, we excluded patients using insulin at the time of target A1c assessment since we can neither assess treatment adherence nor treatment intensification of insulin through pharmacy records.

Multivariate Analyses. We used probit models to assess the marginal effect of patient age on control and treatment intensification for CVD risk factors. We a priori stratified age into four groups: <50 years (reference group), 50–64 years, 65 to 74 years and 75–85 years. All analyses were adjusted for patient gender, baseline laboratory or BP values (recorded at least 3 months prior to poor control event), number of comorbidities, race/ethnicity, preferred language, number of primary care visits in 2005, number of medication classes taken for a condition prior to baseline laboratory or BP value, Medicare status (yes/no), geo-coded education and geo-coded income as fixed effects. We performed geo-coding by linking data from the US Census 2000 on income and education at the block group level to each patient using their address in 2005; resulting education and income level for the block group was used for each patient. Models predicting treatment intensification also adjusted for good vs. poor patient adherence to medications. Treatment adherence was calculated with KP prescription databases[9] using continuous multiple interval measures of gaps in therapy (CMG).[14] We defined good adherence as cumulative days of refill gaps equal to or less than 20% for each condition. Models also adjusted for physician age, gender, race/ethnicity, languages spoken, number of patients in a panel, number of diabetes patients in a panel and for patient clustering within physician using a random effect. For ease of presentation, we converted the resulting marginal effects into adjusted percentages of patients below target for each CVD risk factor and adjusted percentages of patients above target CVD risk factor levels who received treatment intensification for each of the three CVD risk factors. All analyses were performed using STATA version 10.

RESULTS

The characteristics of patients in the study sample by age group are presented in Table 1.

Risk factor control varied by age in both adjusted and unadjusted analyses (Table 2). This was most pronounced for glycemic control, with proportions in control increasing sharply with age (69% for age <50 vs. 91% for age 75–85). In contrast, proportions in control for SBP<140 mmHg decreased with age (78% for age <50 vs. 69% for age 75–85).

Table 1. Baseline Characteristics of Patients in Each Age Group

Characteristic	Age in years			
	<50	50–64	65–74	75–85
Number of patients	30,950	63,006	41,094	26,647
Gender: percent female	47.1	46.2	47.3	51.7
Race/ethnicity (%):				
White	31	43.4	52.1	62
African-American	9	10.6	10.3	8.3
Hispanic	12.4	10.5	11.7	9.4
A/PI*	13.9	15.6	13.8	10.9
Multiple	5.1	4.7	5.8	6.4
Native American	.6	.8	.6	.4
Missing	27.9	14.1	5.6	2.6
Comorbidities (mean)	1.9	2.5	2.9	3.2
Income in dollars (mean)	58,501	61,222	60,401	59,329
Number of drugs (mean)	4.6	7.7	9.2	8.8
PC visits in 2005 (mean)	4.8	5.5	6.4	6.9

A/PI = Asian American or Pacific Islander; number of drugs for the three cardiovascular conditions; PC = primary care

Among patients with poor SBP control, treatment intensification was slightly higher for patient ages 50–64 and ages 65–74 than for patients under age 50 (74.3% and 75.7% vs. 71%, respectively). In contrast, for patients with poor glycemic control, older age was associated with a slightly lower likelihood of treatment intensification (72.8% for those aged 65–74 vs. 76.5% for the reference age group). There was no difference in treatment intensification for poorly controlled lipids by age; however, overall rates of intensification for lipids were lower (<50% for all age groups) than those for A1c and SBP. The relationships between treatment intensification and age were not affected by whether patient medication adherence was controlled for in the model or whether lower thresholds for BP control (SBP<130) were examined (data not shown).

DISCUSSION

Our study demonstrates that treatment intensification was slightly higher among older compared to younger diabetic adults with elevated SBP. Our findings contrast with earlier studies showing lower intensification of antihypertensive regimens for older patients.[13,15] These findings suggest that efforts focused on increasing awareness of the importance of BP control for older patients may be succeeding. In contrast, a lower percent of older adults with poor glycemic control received treatment intensification, and intensification decreased with increasing age. Because of the lack of strong evidence that tight glycemic control is beneficial in older adults, providers may be less likely to intensify regimens.[16] There was no relationship between patient age and treatment intensification for hyperlipidemia, in contrast to previous studies that demonstrated that older adults were intensified less than patients in other age groups.[17,18] Treatment intensification rates for hyperlipidemia were much lower than those for hypertension and hyperglycemia. Future work should identify barriers to appropriate treatment intensification for hyperlipidemia that might improve appropriate lipid control among older diabetes patients.

Table 2. Unadjusted and Adjusted Results for Treatment Intensification and Control for CVD Risk Factors by Age

Age group	Percent well controlled		Percent therapy intensified†	
	Unadjusted (%)	Adjusted (% and CI)	Unadjusted (%)	Adjusted (% and CI)
	SBP<140 mmHg		Intensified hypertension therapy	
<50 years	84.1	78.1	67.7	68
50–64 years	79.6	73.8 (73.1, 74.6)	71.4	70.9 (68.5, 73.3)
65–74 years	76.1	71.6 (70.5, 72.6)	72.2	72.9 (69.8, 76.0)
75–85 years	73.8	69.4 (68.2, 70.5)	69.2	70.8 (67.5, 74)
	LDL cholesterol <100 mg/dl		Intensified lipid lowering therapy	
<50 years	37.1	47.4	46.6	40.7
50–64 years	44.9	49 (48.1, 49.9)	46.4	41.4 (40.2, 42.7)
65–74 years	51.7	52 (50.7, 53.3)	43.4	42.4 (40.4, 44.5)
75–85 years	54	54.2 (52.8, 55.6)	39.9	39.6 (37.4, 41.9)
	Hemoglobin A1c <8.0%		Intensified hypoglycemic therapy††	
<50 years	55.8	69.2	79.2	74.7
50–64 years	64.2	77.9 (77.2, 78.6)	76.6	71.9 (70.4, 73.3)
65–74 years	76	85.8 (84.6, 86.9)	74.9	71.1 (68.6, 73.5)
75–85 years	82.7	91.3 (90, 92.5)	72.7	67.3 (64.4, 70.2)

CVD = Cardiovascular, CI = confidence interval, SBP = systolic blood pressure, A1c = glycated hemoglobin
All analyses adjusted for patient gender, baseline laboratory values, number of comorbidities, race/ethnicity, preferred language, number of primary care visits in 2005, number of medication classes taken for a condition, Medicare status (yes/no), geo-coded education and income as random effects and provider as fixed effects. Reference was age <50 years
†Among those not well controlled
Treatment intensification was defined as any one of the following three occurrences: (1) an increase in the number of drug classes being prescribed, (2) an increase in the daily dosage of at least one ongoing drug class or (3) a switch to a medication in a different drug class
††*Increase in hypoglycemic therapy was only determined for individuals not taking insulin at baseline*

Despite greater level of treatment intensification for BP in older adults, BP control in this group is still somewhat poorer than for younger patients. These findings are consistent with previous studies.[7,19,20] It is also possible that there are factors contributing to poor BP control in the elderly outside of pharmacological treatment. Further studies should explore these relationships and monitor trends in BP levels in diabetes patients across ages over time. It is interesting to note that despite lower treatment intensification for hyperglycemia, older adults had better control of their A1c. Therefore, it is likely that factors other than treatment intensification contribute to improved control for hyperglycemia among older adults. We found that levels of control for LDL-c were lower than for SBP and A1c among older adults. Given the importance of lipid control in order adults, further work should explore the barriers to lipid control in older patients with diabetes.

Limitations

There are a number of limitations in this study that should be noted. Results were based on administrative data, and we were unable to evaluate patient and provider perspectives on the need for treatment intensification. Patients and providers were from a single, large, integrated health-care delivery system; it is possible that rates of risk factor control and treatment intensification may be different in other settings. Finally, we were unable to assess treatment intensification for hyperglycemia in patients already on insulin, which may underestimate our treatment intensification rates in this group.

CONCLUSIONS

Our study demonstrated slightly higher treatment intensification for poor SBP control among older diabetic adults as compared to younger patients. However, control of BP, A1c and LDL cholesterol control varied somewhat by age. While control of SBP in older patients has improved compared to previous studies, older patients still have lower rates of SBP control than their younger counterparts. Further studies that incorporate provider perspectives are necessary to understand provider treatment intensification patterns for older adults and to explore reasons why BP control is persistently lower in older patients with diabetes.

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Conflict of Interest: *None disclosed.*

Author Contributions: *Usha Subramanian MD, MS: study concept and design, interpretation of data, analyses of data, and preparation of manuscript. Julie Schmittdiel PhD: interpretation of data, analyses of data, revising manuscript. Neha Gavin MD MPH: preparation of manuscript. Ana Traylor BA: analyses of data. Connie Uratsu BA: acquisition of data. Joseph Selby, MD, MPH:*

revising manuscript, Carol Mangione MD MSPH: study concept and design, interpretation of the data, and revision of manuscript. All authors have reviewed and approved the final version of the submitted manuscript.

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