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Diabetes

Patient age: A neglected factor when considering disease management in adults with type 2 diabetes

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ABSTRACT

Objective: The average age at diagnosis for type 2 diabetes is decreasing. However, because age is most often controlled for in clinical research, little is known regarding how adult age is associated with diabetes disease-related variables.

Methods: In a community based study with type 2 diabetes patients ($N = 506$), after adjusting for potentially confounding variables, we examined associations between patients' age and: stress, depression, diabetes-related distress, self-efficacy, diet, exercise, and glycemic control. We then explored to what extent age interacts with these variables in their association with glycemic control.

Results: Younger age was independently associated with: greater chronic stress and negative life events, higher levels of diabetes-related distress, higher depressed affect, eating healthier foods and exercising less frequently, lower diabetes self-efficacy, and higher HbA1c. Interactions showed that younger patients with high stress and/or low self-efficacy were more likely to have higher HbA1c levels than older patients.

Conclusions: Results suggest younger adult patients with type 2 diabetes represent a unique patient subgroup with specific needs and health risks based on their developmental stage and life context.

Practice implications: Treatment programs need to target younger adult patients and may need to utilize different media or modalities (e.g., social media) to reach this group.

1. Introduction

From 1988 to 2000, the average age at diagnosis for type 2 diabetes decreased from 52 to 46 years in the Unites States, and the trend indicates that even younger mean ages of diagnosis will occur in the future [1]. Furthermore, the number of adults diagnosed with type 2 diabetes under the age of 44 doubled from 1996 to 2006 [2], and in 2007 it was estimated that almost 1 in 5 newly diagnosed patients with diabetes were between 20 and 39 years of age [3]. This means that type 2 diabetes may no longer be a disease primarily of the elderly and that patients will reflect a much broader adult age range than in the past. Little work has focused on how age or stage of adult life may be associated with important aspects of diabetes and its management. Developmentally linked aspects of work, family and parenting may influence disease distress, depressive affect, disease management, and glycemic control in different ways. With a growing population of younger adult patients diagnosed with type 2 diabetes, patient age will increasingly need to be considered in the design and implementation of programs of education, support and clinical care. To date, however, little information is available about how programs tailored on the basis of age should be developed, and which age-related factors should be addressed.

The overwhelming majority of published studies have either controlled or matched for adult age, thus essentially eliminating age from analysis. Where age effects are reported in studies of type 2 patients, younger adult age has been associated with: a higher likelihood of being an ethnic minority, higher BMI, both higher and lower prevalence of depression, greater stress, poorer diet, and lower diabetes self-efficacy (e.g. [4–7]). Findings regarding the relationship between age and glycemic control have been mixed, with some studies showing higher or lower HbA1c among younger than older patients (e.g. [8]). It remains unclear whether age differences in glycemic control are due to biological factors, psychosocial factors, or both, and for which patients. However, very few of these studies have examined age effects while controlling for potentially confounding patient characteristics, such as time since diagnosis. Furthermore, little work has explored

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to what extent age may interact with other variables, such as patient demographics and psychosocial contextual variables, to predict glycemic control and disease management.

We examined age differences in key aspects of diabetes management, controlling for potentially confounding patient characteristics. Building on previous literature, we asked whether patient age is significantly associated with patient characteristics (behavioral self-management, stress, depressed affect, and self-efficacy) and HbA1c. In exploratory analyses, we also asked if age qualifies the relation between these variables and HbA1c. Our goal was to identify patient characteristics that need to be addressed when designing and implementing programs of education and care for adult patients with type 2 diabetes of different ages.

2. Methods

2.1. Sample and procedures

Patients were recruited from the registries of several community medical groups and diabetes education centers to obtain a diverse community sample. Inclusion criteria were: patients with type 2 diabetes; between ages 21 and 80; read and speak English or Spanish fluently; no diabetes complications that severely limit functional status; and no diagnosis of psychosis or dementia. Letters were sent to each patient from their health care facility, followed by telephone screening. For eligible patients, an appointment was made in the patient's home, our office, or a community setting to explain the project, collect informed consent and begin assessment. Screening identified 640 eligible patients, 506 of whom participated (79%). There were no differences between participants and non-participants found in demographic or diabetes-related variables.

Patients met with a Research Assistant (RA) for a 1.5-h home visit that included an interview, questionnaires, measures of height and weight, a 150-item mail-back questionnaire, and a visit to a community laboratory for collection of blood specimens. All materials were prepared in English and Spanish, and RAs were fluent in both languages.

2.2. Measures

Three groups of variables were identified to examine age effects. First, general patient demographics included: sex (male = 0; female = 1), years of education, self-identified ethnicity (non-white = 0; white = 1), years since diagnosis, BMI, insulin use (0 = no insulin, 1 = insulin), and number of co-morbidities and complications (e.g., renal insufficiency). Second, patient characteristics included: depressed affect, assessed with the Center for Epidemiological Studies Depression Scale (CES-D) [9], a 20-item scale (alpha = .89) that assesses the number and frequency of depressive symptoms over the last seven days; the Diabetes Distress Scale [10], a 17-item measure (1–6 response scale ranging from "not a problem" to "a very serious problem" (alpha = .93) that assesses distress around specific aspects of diabetes management; the number of non-disease-related negative life events was measured by the Negative Life Events Scale (NLE) [11], based on a list of 22 potential stressful events (e.g., death of a friend, crime victim); the Chronic Stressors Scale [11], based on a list of 18 potential chronic, non-health related stressful situations (little money, noisy neighborhood, and problems with children); diabetes self-efficacy was assessed by a 10-item measure (1–4 response scale ranging from "not at all sure" to "very sure"; alpha = .87), which assesses patient confidence performing diabetes specific disease-management behaviors [12]; and self-management was assessed by the diet and exercise components of the Summary of Diabetes Self-Care Activities [7], which records the number of days in the last week patients adhered to their (DIET) or exercise (EXERCISE) plan. Third, HbA1c assessed glycemic control. The project received approval from the UCSF Institutional Review Board and from the Boards of all collaborating institutions. Data was collected between 2004 and 2007 and analyzed in 2009.

2.3. Data analysis

After data cleaning and checking distributions to assure that all scores met assumptions, bivariate associations, using Pearson correlations and chi squares, between age and all patient demographics (e.g., time since diagnosis) were first explored to identify the degree of association between age and potential controls. Regression models were then used to evaluate the independent association between patient age and self-management, stress, depressed affect, self-efficacy, and HbA1c, after controlling for patient characteristics.

Next, in exploratory analyses, interactions were examined following guildelines by Aiken and West [13] using hierarchical multiple regression to determine whether age qualified the associations between patient demographics and HbA1c. Interactions between age and self-management, stress, depressed affect, and self-efficacy on HbA1c were then explored in multiple regression models to determine whether age strengthened or weakened associations after controlling for relevant patient demographics. Significant interaction effects were followed up by post hoc analyses by plotting regression lines for older (+1.5 SD; 72 years) and younger patients (−1.5 SD; 43 years) [13]. Finally, given that age and time since diagnosis are known to be related, further analyses explored their interrelationship with the primary study variables.

A review of descriptive statistics and scatter plots of each variable with age indicated continuous linear relationships, with no gaps to suggest changes based on decade of life or specific age points. Thus, a continuous age variable was utilized in all analyses for increased statistical power. However, for ease of visual interpretation, data for age are presented graphically in the following three age groups: (21–45, 46–64, and 65–80 years).

3. Results

Sample characteristics are presented in Table 1. Average patient age (N = 506) was 57.80 (9.85) years, with a range of 24–80 years. Patient age was correlated significantly with many patient characteristics in correlations with and without controlling for time since diagnosis (presented, respectively): younger patients tended to be diagnosed more recently (r = .31; $p < .05$), have a higher BMI ($r = -.14$; $p < .05$; $r = -.14$; $p < .05$), have fewer co-morbidities (r = .27; $p < .05$; r = .23; $p < .01$), were likely to be

Table 1
Description of the sample (n = 506).

	Mean (SD)
Age	57.80 (9.85)
Sex (1/0 = F/M)	288 (56.9%) female
Education (years)	14.57 (3.37)
Race/ethnicity	
Asian American	85 (16.8%)
African American	104 (20.5%)
Hispanic	98 (19.3%)
Non-Hispanic white	185 (36.7%)
Other	34 (6.7%)
Time since diagnosis	8.14 (7.50)
BMI (kg/m^2)	32.74 (7.74)
Currently using insulin	76 (15%)
HbA1c	7.25 (1.44)

Data are means ± SD or n (%).

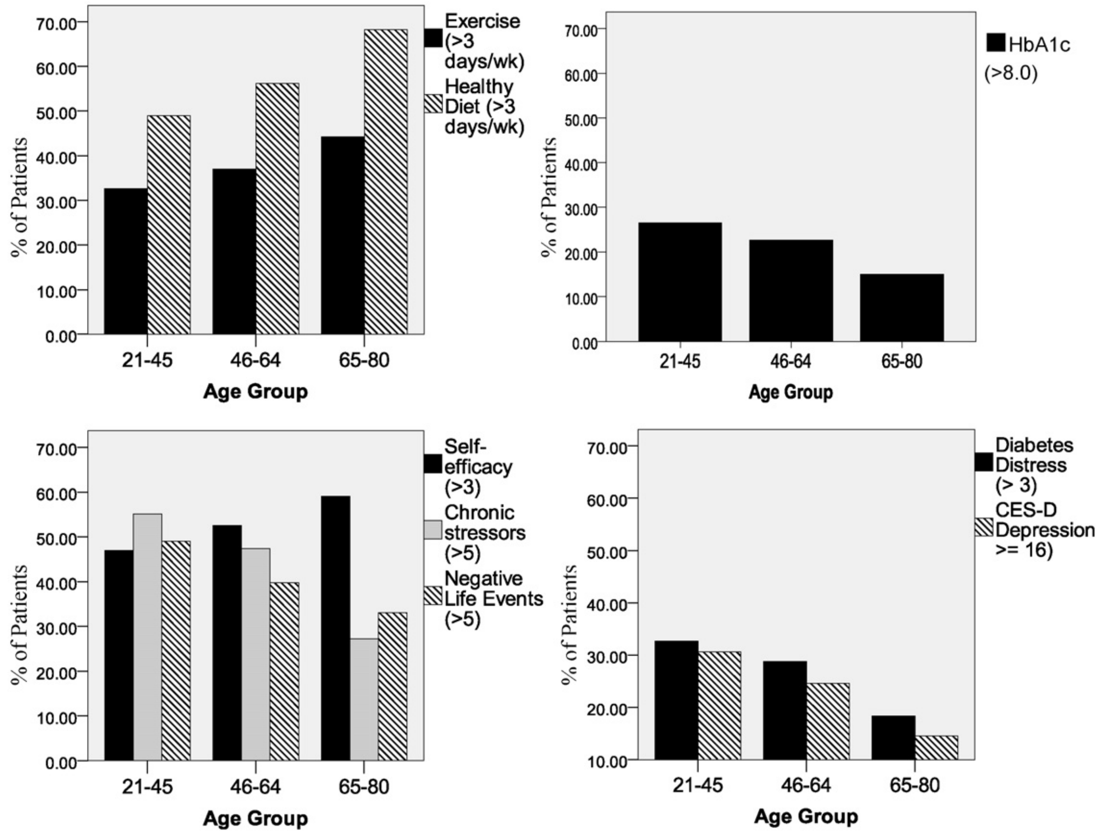

Fig. 1. Age (displayed in three groups for graphical interpretation) by key variables. Dichotomous variables were created as noted in the figure legend.

non-white ($r = .09$; $p = .05$; $r = .11$; $p < .05$), have marginally fewer complications ($r = .08$; $p = .06$), and age was associated with insulin use ($r = .08$; $p = .08$; $r = -.10$; $p < .05$). Age was not significantly related to patient gender or level of education.

3.1. Associations between patient age and key variables

In regression equations, after controlling for patient demographics (i.e., gender, ethnicity, education, time since diagnosis, diabetes complications and co-morbidities, BMI, and insulin), age was significantly associated with HbA1c, with younger adult patients having a higher HbA1c than older patients ($\beta = -.11$; $p < .05$). The percent of patients with an HbA1c above 8.0% was nearly double in age 21–45 year old age group as the 65–80 year old age group (Fig. 1). Controlling for patient demographics, younger age was also significantly and independently associated with each of the following: higher levels of diabetes-specific distress ($\beta = -.21$; $p < .001$); greater

Table 2
Hierarchical regression models predicting HbA1c.

	MR equation with DDS		MR equation with chronic stress		MR equation with self-efficacy	
	β	t Value	β	t Value	β	t Value
Time since diagnosis	.20	3.87***	.20	3.81***	.19	3.78***
Sex (1/0 = F/M)	−.03	−.63	−.02	−.36	−.01	−.23
Education (years)	−.08	−1.72†	−.07	−1.47	−.08	−1.69†
Ethnicity	−.14	−3.11**	−.14	−3.11**	−.16	−3.58***
Comorbidities	−.10	−2.19*	−.08	−1.63	−.10	−2.26*
Complications	.05	1.08	.06	1.21	.05	1.08
BMI	.06	1.29	.07	1.57	.05	1.08
Currently using insulin	.19	3.92***	.19	3.96***	.18	3.75***
Age	−.07	−1.58	−.10	−2.14*	−.08	−1.79†
DDS	.14	3.14**				
Age × DDS	−.10	−2.44*				
Chronic stress			.02	.50		
Age × Chronic stress			−.10	−2.31*		
Self-efficacy					−.15	−3.53**
Age × Self-efficacy					.07	1.74†

Note: Multiple regression equations each include controls and either: (1) DDS and DDS by age, (2) chronic stress and chronic stress by age, or (3) self-efficacy and self-efficacy by age. regression betas are presented from the final step of each hierarchical multiple regression analysis.
† $p < .10$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

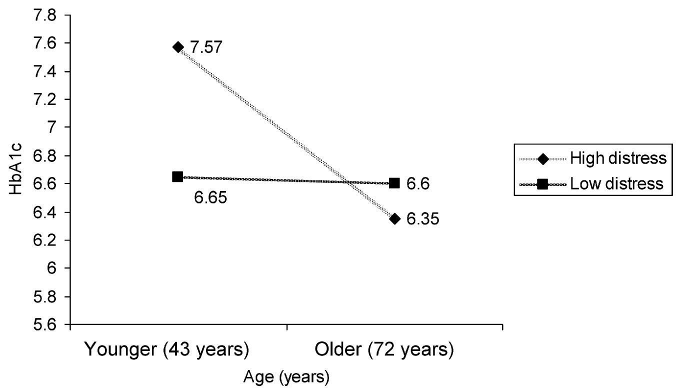

Fig. 2. Interaction between age and diabetes distress on HbA1c plotted at ±1.5 SD of age; $p < .01$.

numbers of both chronic stressors ($\beta = -.28$; $p < .001$) and stressful life events ($\beta = -.13$; $p < .01$); higher levels of depressed affect ($\beta = -.20$; $p < .001$); lower diabetes self-efficacy ($\beta = .18$; $p < .001$); poorer diet ($\beta = .20$; $p < .001$); and less exercise ($\beta = .10$; $p = .05$) (Fig. 1). Given the known linkages between age and time since diagnosis, analyses were repeated to test the effect of time since diagnosis after controlling for age. Time since diagnosis failed to significantly predict any psychosocial measure. Longer time since diagnosis, however, was independently associated with poorer glycemic control ($\beta = .20$; $p < .05$) in these analyses.

3.2. Does age qualify associations between patient characteristics and glycemic control?

Interactions between age and patient demographics on HbA1c were explored in a series of regression equations. The interaction between age and time since diagnosis on HbA1c was marginal ($p = .06$). Only longer duration since diagnosis was associated with higher HbA1c levels among younger patients, whereas no relation between time since diagnosis and HbA1c was found among older patients.

Interactions were then tested between age and each of the patient characteristics on HbA1c in multiple regression models, after controlling for patient demographics. Significant interactions were found between age and diabetes distress ($p < .05$), chronic stressors ($p < .05$), and a marginal interaction was found for self-efficacy ($p = .08$) on HbA1c (Table 2). Post hoc analyses of regression lines revealed two patterns that summarize these interaction results. High levels of chronic stress and diabetes distress were associated with higher HbA1c levels for only the younger patients; no associations were found for older patients. High levels of self-efficacy were associated with lower HbA1c levels only for younger patients; there was no association between self-efficacy and HbA1c for older patients. An example of the first pattern is shown in Fig. 2 for diabetes distress. Interaction analyses were repeated to test the effect of time since diagnosis after controlling for age and were found to be non-significant: suggesting that effects were unique to age and were not replicated for time since diagnosis.

4. Discussion and conclusion

4.1. Discussion

In a heterogeneous, diverse community sample of adult patients with type 2 diabetes, we examined associations between adult patient age and key variables, and then explored to what extent age may qualify the association between patient characteristics and glycemic control. After controlling for potentially confounding patient demographics, relatively younger adult patients, compared to older adult patients, reported experiencing: higher levels of stress – both with respect to negative life events and ongoing chronic stressors, higher levels of depressive affect, greater diabetes-specific distress, poorer self-management behaviors – including poorer diet and less exercise, and lower diabetes self-efficacy. These results suggest that younger adult patients with type 2 diabetes, compared to older adult patients, experience life as more stressful, are more distressed and depressed, and are having a harder time managing their diabetes, both in terms of self-management and glycemic control. Of note is that these findings occurred even in a sample of relatively well controlled patients (where the average HbA1c = 7.25). These findings also demonstrate that age differences function independently of the influence of other patient characteristics, such as time with diabetes. Although age and time since diagnosis are moderately associated, they appear to have somewhat different effects: time since diagnosis is not associated with patient characteristics nor does it interact with patient variables to predict glycemic control whereas age does. Clearly, patient age and the differences in life context reflected by different stages of adult life, which are often overlooked in contemporary diabetes research, are related to many aspects of diabetes management and disease status.

Our findings also indicate that the association between glycemic control and level of patient stress – both diabetes-specific distress and general chronic stress, and self-efficacy differed by patient age. Compared to older patients, younger patients with high levels of stress or those who reported low self-efficacy, had the poorest glycemic control. While among patients with low stress or high self-efficacy, glycemic control did not differ by patient age. Together, the pattern of results suggests that younger patients are not only more likely to experience higher chronic and acute stress, higher disease-related distress and lower self-efficacy than older patients, but that those who do are more likely to have poorer glycemic control than older adult patients.

Patients with an earlier, as opposed to a later age of onset are more likely to have a familial history of diabetes and may also have a higher HbA1c, due to a combination of genetic, lifestyle and other metabolic risk factors [14]. We suggest, however, that at least three broader psychosocial factors also need to be considered. First, for younger adult patients, being diagnosed with and living with type 2 diabetes is developmentally "out of sequence" with the personal and health-related expectations. This may impact diabetes and its management in several ways. At the personal level, patients may have difficulty seeing themselves with a serious chronic disease and incorporating the management of the disease into their lives [15]. Younger adult patients often view themselves as healthy and vibrant, with concerns about health and chronic disease far from their current self-perceptions. At the spouse and family level, family members often experience the same disjunction between young age and ill health, and they may be unprepared to provide the necessary support to patients at a time when adults are expected to be a healthy and in the prime of life. Likewise, it may be more difficult for young adult patients to seek support and understanding or to share their needs with same age peers, who are also less likely than older adults to expect chronic disease among their associates. Thus, there are fewer personal, familial and peer-related resources and supports for these patients, and perhaps higher levels of shame and guilt for having the disease at this stage of life to begin with [16]. Having a chronic disease like diabetes simply may not fit well with self- and other-perceptions and resources at this age.

A second mechanism that may account for these age findings concerns the qualitatively different life stressors and demands that operate at different adult life stages. Younger adults report far more social context, financial, work, and relationship stress than older adults with diabetes [17]. Common stressors during middle adulthood, such as working full-time, raising children, and caring for elderly family members may demand more time and energy than stressors in later adulthood. Furthermore, stresses associated with needs for achievement, education, procreation and raising children are developmentally normative, but they may also lead many patients to place diabetes care at a lower priority, simply because of the sheer number and intensity of other responsibilities. The more immediate demands of family, children and work come before the relatively longer term consequences of diabetes care.

A third mechanism addresses the relationship that these patients may have with their healthcare team. Younger adult patients may not be as familiar or experienced with the healthcare system and my not have the benefit of a long-term, ongoing relationship with a physician or team as older patients [18]. They typically see their health team less often and there may be less continuity of care. Furthermore, younger patients may find programs of diabetes care more focused on the needs and life contexts of older patients, since many programs for type 2 patients are developed to serve the needs of an older generation. Thus, younger adult patients may appear disengaged or disinterested because existing programs do not address their personal and contextual needs directly.

Several study limitations are noteworthy. First, although our patient sample includes a range of patient age and time with diabetes, we recruited relatively fewer younger than older patients. Although there was adequate power to test for age effects, a larger patient sample that includes more young and middle-adult patients would be useful. Second, some age-related results could be due to differential rates of mortality based on age: that is, patients with severe distress and poor management may not have survived to older decades of life. Finally, this is a cross-sectional study and causative relationships cannot be inferred.

4.2. Conclusion

Our findings suggest that younger adult patients with type 2 diabetes report higher rates of distress and depressive affect, lower diabetes self-efficacy for self-management, poorer self-management and poorer glycemic control than older patients. Furthermore, younger patients who experience high levels of stress, depressive affect, or low self-efficacy are more likely to exhibit poor glycemic control than older patients, suggesting a unique patient subgroup with highly specific needs and health risks based on their developmental stage and related life context. Rather than control for patient age in future research, greater attention to adult patient age may help gain sensitivity to the specific needs of this growing population of type 2 patients and to develop programs of care that address these needs directly.

4.3. Practice implications

The clinical implications of these findings include a clearer recognition by diabetes educators and other clinicians that patient age and developmental context form a powerful foundation for the delivery of care, even among adults, who can no longer be considered a homogeneous group. Younger adult patients may benefit from tailoring interventions to address their unique stressors and life demands, especially focusing on personal, work, family and peer relationships and supports. A greater focus on psychosocial context, personal acceptance and prioritizing life demands seem crucial. Last, programs that address the unique challenges of this age group, rather than an attitude of "one size fits all," may be perceived and responded to by these patients as more relevant and applicable to their real world. For example, younger adult patient support and education groups might be more helpful than mixed adult patient groups. Also, younger patients may benefit from different modalities that facilitate their access and enhance their experience with their healthcare team than older patients. Use of open access appointment systems, communicating via automated phone and other electronic media, use of social media, and providing disease management and behavior monitoring programs through web-based systems might fit well with the time demands, skill sets and general experience of this age group. Younger adult patients report greater diabetes knowledge than older patients [19], suggesting that the issues of personal acceptance, life context and clinical care relevance are more likely at play than a simple lack of knowledge about diabetes and its management.

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