Cognitive Abilities and Collaboration in Couples in Type 1 Diabetes Management

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Managing type 1 diabetes involves coordinating complex daily behaviors that may rely on the cognitive abilities of people with diabetes (PWD) and spouses, especially as couples collaborate surrounding diabetes care. The aims of the study were to examine whether *1*) the cognitive abilities of PWD and their spouses predicted lower A1C, *2*) collaborating with a spouse with higher cognitive abilities was especially beneficial for PWD with lower cognitive abilities, and *3*) the benefit of the cognitive abilities of PWD and their spouse occurred through better self-care. Couples ($n = 199$) were recruited with one member diagnosed with type 1 diabetes (PWD 52% female sex, average age 46.81 years, average duration of diabetes 27 years; spouses 48% female sex; average age 46.40 years). PWD and spouses completed fluid (trail making tests from the Delis-Kaplan Executive Function System) and crystallized (information subtest from the Wechsler Adult Intelligence Scale—4th Edition) ability tests. PWD rated their spouse's collaboration in diabetes and reported self-care behaviors through surveys. A1C was assessed as a measure of blood glucose through a blood assay. Multiple regressions revealed that spouses' crystallized ability was the only statistically significant predictor, with higher values associated with lower A1C ($t = -2.17$, $P < 0.05$). The interaction of crystallized ability of PWD × spouse crystallized ability × collaboration indicated that PWD with lower ability tended to benefit more when they collaborated with a spouse who scored higher in ability ($t = -2.21$, $P < 0.05$). Mediational analyses indicated that spouses' crystallized ability was associated with lower A1C through better self-care behaviors of PWD (B = 0.03, SE = 0.01, $P < 0.01$). We conclude that PWD benefit from the cognitive abilities of their spouses through better self-care behaviors that are important for maintaining lower A1C across adulthood.

In 2018, over 1.5 million Americans were living with type 1 diabetes, with the vast majority (85%) of these individuals being adults (1). Individuals with type 1 diabetes need to engage in self-care that minimizes both low and high blood glucose levels to reduce complications of the disease, including micro- and macrovascular disease, neuropathy, blindness, and death (2). However, self-care involves a difficult set of behaviors, including multiple daily blood glucose checks, monitoring food intake and physical activity, and adjusting the amount and timing of insulin administration based on diet, physical activity, and blood glucose levels (3).

Given these challenging self-care behaviors, the cognitive abilities of people with diabetes (PWD) and their spouses may play a role in self-care and in maintaining blood glucose at recommended levels; however, few studies have examined these associations during adulthood (4). Consistent with a link between the cognitive abilities of PWD and A1C, adults with either type 1 or type 2 diabetes in the Health and Retirement Survey who were in the highest quartile of cognitive abilities (a mix of reasoning and vocabulary items) had lower A1C than those in the lowest quartile (5).

Cognitive abilities can be divided into two categories: fluid (involving reasoning and adapting flexibly to new situations) and crystallized (based on accumulated knowledge). As self-care for type 1 diabetes may draw on accumulated experience and knowledge of diabetes, crystallized ability may be especially important in self-care behaviors that have been performed for years. Fluid ability may also be involved in better self-care, especially when a person experiences regimen changes or when encountering an unexpected circumstance. Adults may be at the greatest risk for experiencing higher A1C if both they and their spouse have lower crystallized and fluid cognitive abilities.

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A spouse's cognitive abilities might be especially beneficial when the spouse is involved in the diabetes self-care of the partner with diabetes in supportive and collaborative ways (5). Research indicates that social support broadly mitigates the detrimental effects of PWD's low cognitive function on A1C (5). Since daily diabetes self-care behaviors (e.g., estimating carbohydrates in food and making adjustments of insulin depending on blood glucose values) require accuracy, collaboration with a high-functioning spouse on challenging self-care tasks may be especially beneficial for those PWD who have lower cognitive abilities and thus may have difficulty negotiating these tasks alone.

This study examined the associations of fluid and crystallized cognitive abilities of PWD and their spouses with A1C, controlling for potential confounding variables such as diabetes knowledge and income. We predicted that cognitive abilities of both PWD and spouses would be associated with lower A1C. We examined whether spouses' cognitive abilities were especially beneficial for those PWD who simultaneously had lower cognitive abilities and collaborated with their spouse. Finally, we examined whether the link between cognitive abilities and A1C was mediated by enhanced self-care behaviors.

Research Design and Methods

Participant Recruitment and Procedures

Participants were recruited from two university-affiliated endocrinology clinics in Utah and Pennsylvania. Study procedures were approved by the universities' institutional review boards. People who were ≥25 years of age, were diagnosed with type 1 diabetes ≥1 year ago, were taking insulin for type 1 diabetes within 1 year of their diagnosis, spoke English as their primary language, and were married or in a cohabiting relationship for at least 1 year were eligible to participate. PWD were approached in the clinics. After PWD agreed to participate, their spouse's contact information was obtained. If spouses agreed to participate, couples were enrolled in the study (6).

The final sample included 199 couples. Once PWD and their spouses were recruited for the study, they were emailed online surveys (that included consent forms) to complete at home separately before the in-laboratory visit. During the laboratory visit, couple members were placed in separate rooms to individually complete an additional online questionnaire (containing the self-care measure). Before cognitive testing, PWD were asked to check their blood glucose on a study-provided meter. When PWD had a blood glucose level <70 or >300 mg/dL, we asked them to "do what they would normally do to treat their blood glucose value," after which they checked their blood glucose again. Next, they were individually administered tests of cognitive abilities by a trained research assistant. The laboratory session took 2–2.5 hours to complete (with the survey and cognitive testing lasting ~1–1.5 hours). PWD's A1C was measured in the laboratory. PWD were compensated up to $225 for completing all of the parts of the study ($100 for the initial survey and laboratory assessments plus up to $125 for completing a diary that was part of the larger study and returning a study-owned glucose meter), and spouses were compensated up to $200 (up to $100 for the initial survey and $100 for the diary).

Diabetes Outcomes

A1C

PWD provided a capillary blood sample to measure their A1C level using a Siemens DCA Vantage Analyzer during the laboratory visit.

Self-Care Behavior

PWD completed the Self-Care Inventory (7). They rated how often self-care behaviors (e.g., glucose testing, administering a correct insulin dose, and exercising regularly) were completed as recommended in the past month on a five-point scale (from 1 = did not do to 5 = always did without fail). One item (ketone testing) was dropped from the original measure based on health care provider recommendations, leaving 13 items from the original 14-item scale. The scale exhibited acceptable reliability in this sample ($\alpha = 0.76$). The average ratings of the items was used.

Cognitive Abilities

"Crystallized ability" refers to acquired knowledge and experience (8). As an estimate of crystallized ability, PWD and their spouses completed the Information subtest from the Wechsler Adult Intelligence Scale—4th Edition (9). The Information subtest is an index of general world knowledge that a person has acquired. It correlates at 0.75 with the Full-Scale IQ instrument and, even more importantly, at 0.89 with the Verbal Comprehension Index, which is a comprehensive index of crystalized intelligence (9). Test-retest reliabilities across adulthood are excellent at ≥0.9 (9).

"Fluid ability" refers to cognitive processes that are not dependent on prior knowledge; instead, they are thought to reflect native efficiency, flexibility, and control of cognitive processing (8). Although fluid ability has traditionally been assessed by tests of novel reasoning (e.g., Raven's matrices) (10), recent research has demonstrated that such reasoning measures tap into education and prior learning to a similar extent as measures of crystalized intelligence (11), which is inconsistent with the accepted conceptualization of the fluid ability construct. In contrast, speed of processing, which is an index of the efficiency of cognitive processing, exhibits a much lower association with prior learning (11) and has consistently been shown to be the driver of reasoning, from both the developmental (12) and aging (13) standpoints. Therefore, as an estimate of fluid ability, PWD and their spouses completed three conditions from the trail making test from the Delis-Kaplan Executive Function System, which together tap into speed of processing in visual and motor domains and other key fluid processes such as mental flexibility, working memory, and attention (14). Internal consistency of the trail making composite was acceptable for both PWD ($\alpha = 0.78$) and spouses ($\alpha = 0.73$). We analyzed norm-based, age-corrected, scaled scores for both tests. The normative sample mean is 10 (SD 3).

Collaborative and Supportive Strategies

PWD rated seven items tapping collaboration (e.g., "My partner and I worked together to manage diabetes") and instrumental support (e.g., "My partner suggested things that might help me manage diabetes") (6). PWD indicated how often each behavior occurred between them and their spouse during the past month on a five-point scale (from 1 = not at all to 5 = very often). Reliability was excellent ($\alpha = 0.94$; for more details, see Helgeson et al. [6]).

Diabetes Knowledge

The Michigan Diabetes Research and Training Center's Brief Diabetes Knowledge Test (15) was used to determine both PWD's and spouses' knowledge of diabetes and its care. This measure consists of 23 items asking participants to answer multiple-choice questions regarding various aspects of diabetes care, including the nutritional value of foods, medical terminology, practices associated with diabetes care, diabetes-related complications, and insulin-related knowledge, with acceptable reliability ($\alpha > 0.70$) (10). Items were scored using the provided answer key, and a count score was created, with higher scores indicating greater diabetes-related knowledge.

Comorbidity

Comorbid illnesses and conditions were assessed using the Self-Administered Comorbidity Questionnaire, a self-report measure that assesses the presence of 12 common health problems (e.g., heart disease and diabetes) and allows participants to list up to three additional problems. The questionnaire is sum-scored. This measure had good test-retest reliability (intraclass correlation coefficient = 0.94) in a sample of PWD (16).

Analytic Plan

Missing data for key study variables ranged from a low of 0.5% to a high of 4.5%. To account for missing data, we generated 10 data sets through multiple imputation (MI) (17), including 46 demographic, health, and cognitive variables beyond the primary study variables in the present article to ensure that an adequate missing-at-random model was generated. The lowest relative efficiency for the regressions was 0.99, suggesting that the MI procedure adequately recovered missing data.

To address whether PWD's and spouses' cognitive abilities predicted A1C, we conducted a multiple regression. Time since diagnosis, continuous glucose monitoring (CGM) use, PWD's report of family income (from 1 = <$15,000 to 11 = >$100,000), PWD's knowledge, and PWD's comorbidities were covariates, given their association with A1C or cognitive abilities (Table 1). Age, PWD's and spouses' cognitive abilities, and two-way interactions of PWD's and spouses' cognitive abilities were interaction terms as independent variables. Interactions were calculated by centering variables at the grand mean and then computing product terms. Because PWD's and spouses' knowledge levels were not associated with A1C (nor did their inclusion change the multiple regression results), these covariates were dropped from the analyses. Furthermore, because no age effects or interactions with age were found with any variables ($P > 0.05$), interactions with age were dropped from the analyses. A similar multiple regression was conducted including those cognitive abilities (of PWD or spouses) that were predictive of A1C, together with PWD's perceptions of collaboration, and the interactions of collaboration with PWD's cognitive abilities and collaboration with spouses' cognitive abilities, and the three-way interaction of collaboration with PWD's cognitive abilities and spouses' cognitive abilities. All analyses were estimated using SPSS Mixed, v. 27, statistical software (IBM Corp.).

To the extent that relations between cognitive ability and A1C were found, mediational analyses examined whether relations were explained by higher rates of self-care behaviors by PWD using the Model Indirect command in Mplus, v. 7.11 (Muthén & Muthén). Model Indirect used the delta method to test the indirect effect of cognitive ability on A1C via self-care behaviors. For mediation analyses, full information maximum likelihood estimation

TABLE 1 Demographics of PWD and Spouses

	PWD	Spouses
Age, years, mean	46.81	46.40
Female sex	52.3	47.7
White race	92.5	97.9
Hispanic ethnicity	6	3.1
Educational status		
Less than high school	0	1.5
General education degree	2.0	0.5
High school graduate	10.1	10.1
Some college (did not graduate with degree/certificate)	16.1	20.2
Associate's degree/vocational degree	12.1	14.6
Bachelor's degree	32.2	29.3
Master's degree	16.6	16.7
Doctorate*	11.1	7.1

Data are % unless otherwise noted. *Doctor of Medicine, Doctor of Philosophy, or Juris Doctor degree.

was used to account for missing values in the raw (unimputed) data.

Results

Demographics and Preliminary Analyses

The sample included 199 couples (398 individuals). Participant demographics are summarized in Table 1. The majority of the sample (92%) were married, in heterosexual relationships (97%) with an average relationship length of 19.36 years (SD 14.56 years, range 1–52 years). Given the high percentage of married individuals, we refer throughout this report to partners as spouses. PWD were, on average, 46.81 years of age, and spouses were, on average, 46.40 years of age. The majority of PWD and spouses were White and non-Hispanic; roughly half of PWD were women. PWD had been diagnosed with type 1 diabetes for a mean of 27.25 years (Table 2), with 69% using an insulin pump and 43% using CGM. In general, PWD and spouses were highly educated (mean education level between associate's/vocational degree and bachelor's degree) with an annual household income slightly above the $70,000–80,000 range. Participants at the Pennsylvania site were older ($P < 0.01$) and had diabetes for a longer period of time ($P < 0.05$) than participants at the Utah site but did not differ with respect to other demographic variables. There were no site differences in cognitive abilities or A1C; however, self-care was higher in Pennsylvania than in Utah ($P < 0.01$). Upon checking blood glucose levels before cognitive testing, 24 individuals were found to have an initial reading ≤70 or >300 mg/dL. (Of these, four were within range after rechecking, two refused to recheck, six did not recheck after providing an explanation for why they felt their blood glucose values were high, and documentation was missing for the remaining 12.) Correlations between blood glucose measured before cognitive testing and cognitive abilities were not significant ($r = 0.11$ for crystallized ability and $r = -0.08$ for fluid intelligence; $P > 0.10$ for both).

PWD and spouses scored about 1–2 scaled points higher than age-matched individuals for crystallized ability and fluid ability, placing them into the high-average range. See Table 2 for means and correlations. Reports of collaboration and supportive strategies were in the moderate range. Average A1C was 7.57 ± 1.06%, which was higher than the American Diabetes Association (ADA)'s recommended general target of <7.0% (2). PWD's and spouses' crystallized ability levels were positively correlated; there was no correlation between PWD's and spouses' fluid ability. Fluid and crystallized ability levels were positively associated for both PWD and spouses. Higher crystallized ability for PWD and for spouses was associated with lower A1C. Higher fluid ability for PWD was associated with lower A1C, but no association was found for spouses' fluid ability. Higher crystallized ability for PWD was also associated with lower use of collaborative and supportive strategies. Greater crystallized ability for spouses, but not PWD, was associated with PWD's reports of greater self-care behaviors.

PWD's and Spouses' Cognitive Abilities, Collaboration, and A1C

The multiple regression using A1C as the dependent variable revealed that only spouses' crystallized ability was a statistically significant predictor of A1C. When spouses' crystallized ability was higher, PWD had lower A1C (Table 3). No interaction was found between PWD's and spouses' crystallized or fluid ability levels. This multiple regression accounted for 13% of the variance in A1C.

A second multiple regression (Table 4) including only crystallized ability of PWD and spouses and collaboration with spouses, was conducted to predict A1C. A significant interaction among PWD crystallized ability, spouses' crystallized ability, and collaboration was found. Plotting the interaction 1 SD above and below the mean of collaboration revealed that spouses' crystallized ability was more beneficial for PWD with lower crystallized ability who also reported collaborating more frequently with their spouse (Figure 1). However, tests of simple slopes revealed that no slope was significantly different from zero ($P > 0.997$ for all) and that no pairs of slopes were significantly different from each other ($P > 0.998$ for all). This multiple regression accounted for 16% of the variance in A1C.

TABLE 2 Means, SDs, and Correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. PWD crystallized score	11.11	2.85	—															
2. Spouse crystallized score	11.45	2.74	0.38**	—														
3. PWD fluid score	11.39	1.92	0.32**	0.08	—													
4. Spouse fluid score	11.77	1.68	0.08	0.17*	0.09	—												
5. Spouse age, years	46.40	14.17	−0.13	−0.03	−0.08	0.29**	—											
6. PWD age, years	46.81	13.95	−0.10	−0.04	−0.11	0.28**	0.95**	—										
7. Self-care score	3.67	0.056	−0.04	0.20**	−0.04	0.07	0.28**	0.24**	—									
8. A1C, %	7.57	1.06	−0.21**	−0.25**	−0.16*	0.04	0.10	0.13	−0.32**	—								
9. PWD collaboration score	2.83	1.09	−0.16*	−0.04	−0.15*	−0.05	−0.07	−0.03	−0.02	0.06	—							
10. Diabetes duration, years	27.25	14.06	−0.11	0.00	−0.18*	0.25**	0.64**	0.64**	0.19**	0.02	−0.02	—						
11. CGM (1 = CGM use)	0.43	0.50	0.08	0.02	−0.02	0.01	−0.16*	−0.13	0.03	−0.06	0.06	−0.06	—					
12. PWD comorbidities score	2.24	1.44	−0.15*	−0.12	−0.33**	0.06	0.36**	0.43**	0.02	0.16*	0.01	0.33**	−0.09	—				
13. Spouse comorbidities score	0.96	1.13	−0.12	−0.14	−0.19**	0.06	0.33**	0.31**	0.05	0.12	0.01	0.17*	0.04	0.29**	—			
14. Income	8.23	3.02	0.26**	0.24**	0.25**	0.25**	0.09	0.11	0.11	−0.10	−0.23**	0.05	0.08	−0.17*	−0.13	—		
15. PWD knowledge score	20.51	1.95	0.41**	0.25**	0.18*	0.13	0.01	0.04	0.07	−0.13	−0.18*	0.20**	0.05	−0.09	−0.04	0.26**	—	
16. Spouse knowledge score	18.26	2.75	0.28**	0.30**	0.03	0.02	0.09	0.03	0.05	−0.04	0.08	0.11	0.13	−0.07	−0.04	0.17*	0.33**	—

*P <0.05. **P <0.01.

Mediation of the Spouses' Crystallized Ability and A1C Link

A mediational analysis examining whether spouses' crystallized ability was associated with better A1C through self-care is depicted in Figure 2. The indirect effect of spouses' crystallized ability through PWD's reports of self-care on A1C was significant. This is consistent with self-care by PWD being a plausible mediator of spouses' crystallized ability effects on A1C. A mediational analysis examining whether the relationship between PWD's crystallized ability and A1C was mediated through PWD's reports of self-care revealed no evidence of mediation (indirect effect was not significant [P >0.08]).

Discussion

The results suggest that crystallized ability, in particular, is a resource that can be drawn upon to benefit A1C. Although both crystallized ability of both PWD and spouses showed negative zero-order associations with lower A1C, only spouses' crystallized ability was uniquely associated with A1C. The cross-sectional association of PWD's crystallized ability with A1C may reflect that people with type 1 diabetes use accumulated knowledge that has been gained over numerous years to facilitate healthy A1C levels. However, given that this is a cross-sectional relation, it is also possible that hyperglycemia has detrimental effects on cognitive abilities, limiting some individuals' ability to fully acquire the requisite knowledge and skills in the first place (18).

Although PWD's fluid ability did relate to A1C, when PWD's crystallized ability was included, this relation was no longer significant. It was somewhat surprising that PWD's and spouses' fluid ability levels did not predict over and above their crystallized ability, as fluid ability has been related to measures of everyday problem-solving (19). It is possible that fluid ability was not uniquely predictive because PWD and spouses had been dealing with type 1 diabetes for numerous years, with their accumulated knowledge thus being more important than how they adjust to new situations.

The finding that crystallized ability predicted over and above diabetes knowledge suggests that crystallized ability more broadly than simply knowledge about diabetes is a resource for more effective self-care. Fluid ability may be more predictive, since PWD and spouses adjust to novel situations such as adjusting to new technologies and adapting to new complications that challenge longstanding self-care routines. In addition, given that this sample was close to meeting A1C targets and had good fluid ability relative to national norms, greater relations may be found in a

TABLE 3 Crystallized and Fluid Ability Predicting A1C

Variable	B (SE)	*t*	*P*
Intercept	7.77 (0.35)	22.13	0.00
PWD age	0.01 (0.01)	1.25	0.21
PWD comorbidities	0.06 (0.06)	0.91	0.36
Diabetes duration	−0.01 (0.01)	−1.43	0.15
CGM use	−0.07 (0.15)	−0.49	0.63
Income	−0.00 (0.03)	−0.14	0.89
Spouse crystallized	−0.08 (0.03)	−2.62	0.01
PWD crystallized	−0.04 (0.03)	−1.19	0.24
Spouse fluid	0.05 (0.05)	1.09	0.27
PWD fluid	−0.05 (0.05)	−1.04	0.30
Spouse crystallized × PWD crystallized	0.00 (0.01)	0.23	0.82
Spouse fluid × PWD fluid	−0.00 (0.03)	−0.09	0.93

R^2 = 0.13.

more cognitively diverse sample of adults. Replications of this finding are needed with a broader range of measures of fluid intelligence and a more cognitively diverse sample of adults.

The interaction between PWD's crystallized ability, spouses' crystallized ability, and collaboration suggests that spouses' crystallized ability may be especially beneficial in the context of working collaboratively with PWD who have lower crystallized ability. These results add to findings in the literature (5) that social support for diabetes moderated the detrimental effect of lower cognitive ability on blood glucose. High-functioning spouses who collaborate with their spouses with diabetes who have lower cognitive abilities may be able to compensate for those lower abilities, providing important support for self-care behaviors. This compensation may be especially important in late adulthood, as crystallized ability may be needed to manage aspects of diabetes self-care that may change across the adult life span, such as the greater risk of hypoglycemia that occurs with advanced age and age-related cognitive decline (20). However, this three-way interaction should be interpreted with caution, since the individual slopes were not statistically significant. The restriction in range of crystallized ability to normal levels may have limited our ability to detect significance in these slopes.

The relation between spouses' cognitive abilities and A1C, and the fact that this association was mediated through self-care, is the first demonstration to our knowledge that spouses' cognitive abilities may play a role in self-care behaviors related to chronic illnesses. Our qualitative

TABLE 4 Crystallized Ability and Collaboration Predicting A1C

Variable	B (SE)	*t*	*P*
Intercept	7.68 (0.34)	22.62	0.00
PWD age	0.01 (0.01)	1.22	0.22
PWD comorbidities	0.06 (0.06)	1.10	0.27
Duration of diabetes	−0.01 (0.01)	−1.05	0.30
CGM use	−0.13 (0.15)	−0.85	0.40
Income	−0.01 (0.03)	−0.22	0.82
Spouse crystallized	−0.06 (0.03)	−2.17	0.03
PWD crystallized	−0.05 (0.03)	−1.64	0.10
PWD collaboration	−0.04 (0.08)	−0.52	0.60
PWD crystallized × spouse crystallized	0.01 (0.01)	0.86	0.39
Spouse crystallized × collaboration	0.00 (0.03)	0.11	0.92
PWD crystallized × collaboration	−0.04 (0.03)	−1.43	0.15
PWD crystallized × spouse crystallized × collaboration	0.02 (0.01)	2.21	0.03

R^2 = 0.16.

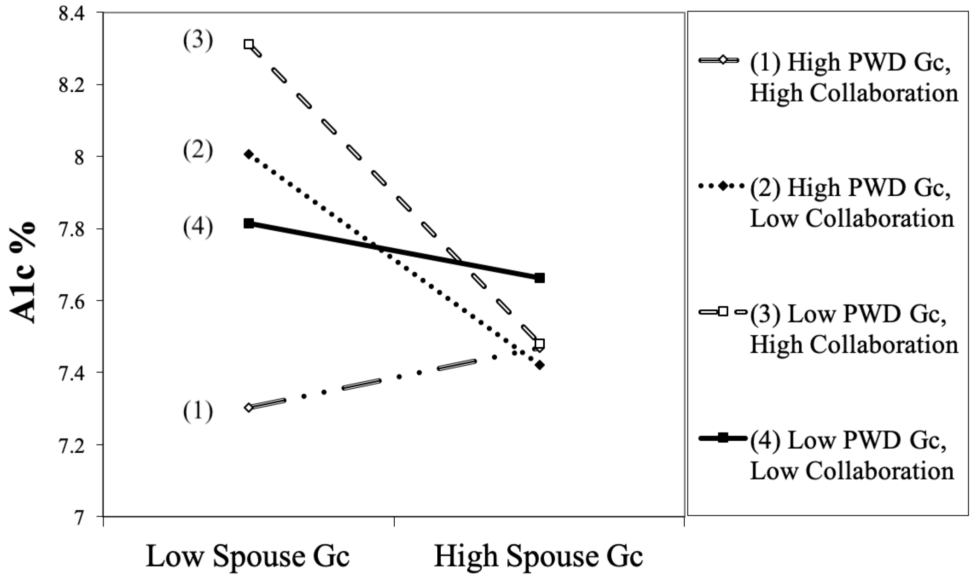

FIGURE 1 Relationships between spouse crystallized ability (Gc) and A1C moderated by PWD Gc and collaboration.

research with this sample indicates that spouses are assisting in a variety of ways that could benefit from higher cognitive abilities: weighing food to support accurate insulin dosing, planning in advance to carry snacks as treatment for low blood glucose levels, troubleshooting technology problems, and offering reminders to their spouse with diabetes to check glucose with a meter or via CGM (21). Future research is needed to explore what resources spouses with higher cognitive abilities provide in assisting with self-care behaviors that result in lower A1C levels.

These results should be interpreted in the context of some limitations. First, the sample was primarily non-Hispanic White participants who were advantaged in terms of being highly educated, in long-term romantic relationships, and experiencing A1C levels relatively close to target, although still higher than the ADA's recommendation for most adult PWD (2). These sample characteristics limit the generalizability of the findings. Future research is needed with more educationally diverse samples of adults, especially those with a greater range of cognitive abilities, and additional metrics of cognitive function beyond those assessed here. Cognitive abilities may be even more predictive of A1C in samples with very low levels of cognitive abilities. Second, although the selected measures of fluid ability examined in this study were not associated with A1C in this sample, this finding could have been the result of the particular types of fluid ability examined in the study. Future research is needed examining a broader range of fluid cognitive abilities. Third, the Diabetes Knowledge Test used in this study has primarily been used to assess the knowledge of people with type 2 diabetes and may not have captured knowledge that is more specific to people with type 1 diabetes (e.g., the use of CGM in diabetes care). Fourth, all of our couples were in cohabitating relationships, and the role of romantic caregivers who are not cohabitating may be different. Finally, the cross-sectional nature of the study limits conclusions regarding the direction of effects. Future research is needed to explore how cognitive abilities may predict future self-care and A1C.

In conclusion, our results point to the importance of the role spouses may play in the care of adults with type 1

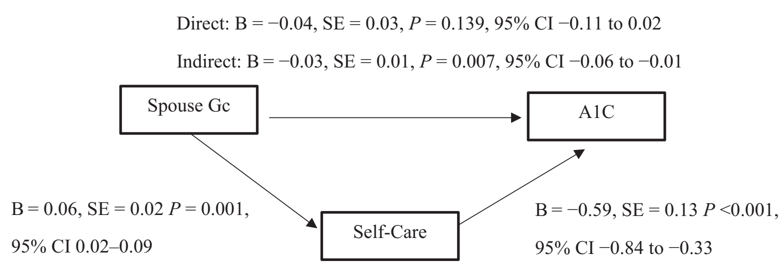

FIGURE 2 Mediational analysis of link between spouse crystallized ability (Gc) and A1C.

diabetes and enhance understanding of the additional resources spouses may bring to diabetes management across the adult life span. Because adults with type 1 diabetes are faced with new technologies such as CGM and changes in their self-care regimen, spouses may play an important role in assisting with these changes. These results provide support for couples-based interventions that emphasize ways that PWD and their spouse may collaborate on daily self-care tasks that may benefit A1C across the life span (22).

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DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

C.A.B. wrote the manuscript and designed the study. Y.S. assisted with writing the manuscript and designing the study. R.G.K.d.G., A.M., and J.B. assisted with data imputation and analysis. N.A.A. and M.S.C. assisted with editing the paper. V.S.H. collaborated in the design of the study and edited the paper. C.A.B. 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 the accuracy of the data analysis.

PRIOR PRESENTATION

Portions of these data were presented at the Gerontological Society of America Annual Scientific Meeting, 13–17 November 2019.

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