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Family Members' Obstructive Behaviors Appear to Be More Harmful Among Adults with Type 2 Diabetes and Limited Health Literacy

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Abstract

Family members' obstructive diabetes-specific behaviors (e.g., nagging/arguing or getting in the way of patients' self-care) are associated with adults having worse glycemic control (HbA_{1C}), with supportive family behaviors protecting against this detrimental effect. Given the role of family members in helping patients with limited health literacy (HL), patients' HL status may moderate these relationships. We tested this hypothesis with 192 adults with type 2 diabetes. Twenty-six percent had limited HL, and limited HL was associated with more supportive family behaviors ($p < .05$), but not with obstructive family behaviors or with patients' HbA_{1C}. Adjusted stratified analyses indicated obstructive family behaviors were more strongly associated with worse HbA_{1C} among participants with limited HL and low supportive family behaviors than for participants with adequate HL and low supportive family behaviors (adjusted simple slopes $\beta = 0.70$, $p = .05$ versus $\beta = 0.36$, $p = .009$). However, there was no association between obstructive family behaviors and HbA_{1C} in the context of high supportive family behaviors, regardless of HL status. Involving family members in adults' self-care without teaching them to avoid obstructive behaviors may be particularly harmful for patients with limited HL. Future research should identify intervention content to reduce obstructive family behaviors and identify which supportive family behaviors may be protective.

Limited health literacy (HL) is common among older adults managing a chronic condition (Dewalt et al., 2004; Henry et al., 2013; Paasche-Orlow et al., 2005), and is linked to worse self-management (Dewalt et al., 2004) and adverse health outcomes (Bostock & Steptoe, 2012). Patients may leverage resources from their social and family networks to overcome barriers related to limited HL and avoid adverse health outcomes. Social networks may

assist patients manage their health by: (a) creating social norms around positive health behaviors (Tucker, 2002), (b) acting as surrogate decision makers (Levine & Zuckerman, 1999), (c) helping to navigate the healthcare system (Jordan et al., 2010), (d) reminding patients to go to healthcare appointments and/or perform self-care behaviors (Lee et al., 2006), and (e) assisting patients in accessing health information (Mayberry et al., 2011). Such assistance may be particularly beneficial for patients with limited HL (Jordan et al., 2010; Lee et al., 2006; Mayberry et al., 2011).

By treating HL as an individual characteristic, previous literature has often overlooked the potential for social networks to ameliorate the adverse effects of limited HL on access to care and health outcomes (Lee et al., 2004). In 2004, Lee et al. put forth a research agenda focusing on the interrelationships between HL, social support, and health status. They suggested positive social support may protect persons with limited HL from potential adverse health outcomes, and negative or harmful interactions with social network members may exacerbate these potential adverse health outcomes (Lee et al., 2004). In short, social networks may matter more for patients with limited HL in both protective and detrimental ways. In diabetes, glycemic control (HbA_{1C}) is a critical marker of health status, as it indicates the severity of the disease and worse HbA_{1C} is associated with increased risk of complications and premature mortality (Holman et al., 2008). A couple of studies have explored the role of social support in the pathway between HL and diabetes outcomes (Osborn et al., 2010; Rosland et al., 2010), but to our knowledge no study has explored how social or family support may affect diabetes outcomes differently for adults with limited HL versus those with adequate HL.

Because diabetes management occurs in the context of routine family activities, family members are an essential source of support for self-care among adults with type 2 diabetes mellitus (T2DM) (Fisher, 2006; Rosland et al., 2012). In a recent mixed-methods study, we found that adults with T2DM spontaneously mentioned family members' behaviors when discussing their diabetes self-management in each of eleven focus groups (Mayberry & Osborn, 2012). Focus group participants described how observable behaviors of their family members made their self-care easier or possible (Mayberry & Osborn, 2012). For instance, participants described how family members ordered and picked up prescription refills, reminded patients to take medications, carried healthy snacks or medications with them for the patient, exercised with the patient, or purchased and prepared healthy foods (Mayberry & Osborn, 2012).

However, family members also performed obstructive behaviors, which made patients' self-care more difficult. Patients described how family members nag or argue with them in an attempt to get them to perform self-care behaviors (Carter-Edwards et al., 2004; Hagedoorn et al., 2006; Mayberry & Osborn, 2012). Such nagging or "miscarried helping" tends to reduce patients' self-efficacy, leads patients to "dig in their heels," and creates family conflict (Harris, 2006; Stephens et al., 2013). Family members may also sabotage or undermine patients' self-care attempts by tempting them with unhealthy foods or disregarding the importance of self-care behaviors (Henry et al., 2013; Mayberry & Osborn, 2012). Supportive and obstructive behaviors are not mutually exclusive; patients often report

that their family members perform both supportive and obstructive behaviors (Henry et al., 2013; Mayberry & Osborn, 2012, under review; Stephens et al., 2013).

Given the role social and family networks may have in helping patients with limited HL (Jordan et al., 2010; Lee et al., 2006; Mayberry et al., 2011), these patients may be uniquely impacted by supportive and obstructive family behaviors. Family member involvement in diabetes management may help some patients overcome HL-related barriers, potentially explaining inconsistent associations between limited HL and worse HbA_{1C} (Al Sayah et al., 2013). We previously found obstructive family behaviors were associated with worse glycemic control, but supportive family behaviors were not associated with better glycemic control (Mayberry & Osborn, under review). However, supportive family behaviors modified the effect of obstructive family behaviors on worse glycemic control, such that obstructive family behaviors were only associated with worse glycemic control when supportive family behaviors were low, but not when supportive family behaviors were high (Mayberry & Osborn, under review).

Pursuant to Lee et al.'s (2004) hypotheses, our objective for the present study was to test whether these relationships were moderated by HL status. Specifically, we assessed whether obstructive family behaviors had a stronger relationship with worse glycemic control among patients with limited HL than among those with adequate HL (HL X obstructive). We also assessed whether supportive family behaviors were associated with better glycemic control only among patients with limited HL (HL X supportive), or whether supportive behaviors were more likely to protect against the effects of obstructive behaviors on worse glycemic control among patients with limited HL (HL X supportive X obstructive). Because limited HL is common among patients who receive care at Federally Qualified Health Centers (FQHCs) (Arnold et al., 2012), we explored these hypotheses with a racially diverse sample of adults with T2DM receiving care at a FQHC.

Methods

We conducted secondary analysis with a subsample of participants in a larger cross-sectional study assessing modifiable determinants of diabetes medication adherence among adults receiving outpatient care for T2DM at a FQHC in Nashville, TN. The parent study recruited 314 participants from June 2010 to November 2012; the subsample included in this secondary analysis (n=192) participated after measures assessing family members' behaviors were added in June 2011. Patients were consecutively screened for eligibility and enrolled by trained research assistants (RAs) as they arrived for their scheduled clinic appointment. Eligible participants were English- or Spanish-speaking adults (age ≥ 18 years) diagnosed with T2DM and prescribed oral hypoglycemic agents and/or insulin. RAs in collaboration with clinic personnel screened for exclusion criteria, including not having a social security number required for compensation, unintelligible speech, delirium, severe hearing impairment, and administration of all medications by a caregiver. For the parent study, RAs approached 86% (507 out of 588) of patients with T2DM who arrived for a clinic appointment during the study period; 58 declined participation without being screened for eligibility and 135 were ineligible (Mayberry et al., 2013). The remaining 314 (62% of those approached) were enrolled and participated.

RAs met with interested and eligible participants in private rooms in the clinic before/after their scheduled appointment. RAs read items and response options aloud to participants (except the HL assessment, described below) to ensure literacy limitations did not confound responses. Patients were also given copies of each set of response options in large print, so they could say and/or point to their response. Participation took approximately one hour and participants were compensated \$20. The Vanderbilt University Institutional Review Board approved all study procedures.

Measures

We collected participant-reported age, gender, race, ethnicity, income, education, insurance status, and diabetes duration. RAs reviewed participants' medical records for the number and type of prescribed diabetes medication(s).

Health literacy (HL) status was assessed with either the English or Spanish Short Test of Functional Health Literacy in Adults (S-TOFHLA) (Baker et al., 1999; Parker et al., 1995) based on participants' preferred language. We used dichotomous categorization of HL (>23 adequate versus ≤23 limited) (Baker et al., 1999). Sixteen participants did not complete the S-TOFHLA; six reported they were illiterate and were categorized as having limited HL, one skipped a page and was categorized based on percent correct of items completed, eight reported problems seeing and one left before completing study materials and were excluded from analysis, resulting in a final sample of $n=183$.

Family behaviors were assessed with the Diabetes Family Behavior Checklist-II (DFBC-II) (Glasgow & Toobert, 1988). The 16-item DFBC-II asks respondents how often their family members have performed diabetes-specific behaviors in the past month on a scale from 1=never to 5=at least once a day. Supportive behaviors include "exercise with you" or "eat at the same time that you do," whereas obstructive behaviors include "criticize you for not exercising regularly" or "eat food that are not part of your diabetic diet." We averaged the nine supportive items and seven nonsupportive items to create two subscales ranging from 1–5, with higher scores indicating more supportive or obstructive behaviors, respectively (Glasgow & Toobert, 1988). The DFBC-II has good internal consistency reliability, test-retest reliability, and has been validated against family member report (Schafer et al., 1986). Licensed translators adapted the DFBC-II to Spanish using the forward-backward technique (Behling & Law, 2000).

Glycemic control was assessed with a valid and reliable point-of-care HbA_{1C} (%) test (Kennedy & Herman, 2005) administered by clinic nurses on the date of study participation.

Analyses

We used Stata 12 to conduct all analyses. First, we used Mann-Whitney U tests and Fisher's exact tests as appropriate to examine associations between HL status (adequate versus limited) and all other variables of interest (Table 1). Then, we used analysis of covariance (ANCOVA) models to test the adjusted relationships between HL status and supportive and obstructive family behaviors, and between HL status and HbA_{1C}.

Next, we examined whether HL moderated associations between obstructive or supportive family behaviors and HbA_{1C} using a series of unadjusted and adjusted ordinary least squares regression models (see Table 2). Continuous variables were mean-centered to create interaction terms. Model 1 assessed the HL X supportive family behaviors interaction term, Model 2 assessed the HL X obstructive family behaviors interaction term. Models 3 and 4 reexamined these interaction terms, adjusted for the supportive X obstructive family behaviors interaction term. Model 5 examined the three way interaction (HL X supportive X obstructive family behaviors) to assess if the moderating effect of supportive family behaviors on the association between obstructive family behaviors and HbA_{1C} (Mayberry & Osborn, under review) was consistent regardless of HL status. We ran each of these models twice, once unadjusted and once adjusted for covariates, for ten models total.

Finally, we stratified the sample by HL status to explore these relationships. While interaction terms test the hypothesis that associations across groups are significantly different from one another, stratification provides information as to which associations are significantly different from zero within each group. Stratification is also useful in this instance because the addition of covariates may have reduced our power to detect interaction effects in adjusted regression models, but not adjusting for covariates may lead to confounding bias. Therefore, we used both interaction effects and stratified effects to evaluate the hypothesized effects.

We used robust standard errors for conservative estimates despite heteroskedasticity in all models. Because of the positive correlation between supportive and obstructive family behaviors (Mayberry & Osborn, under review), adjusting for supportive family behaviors when examining associations with obstructive family behaviors “suppresses” shared variance, allowing for examination of the independent effects supportive family behaviors and vice versa. Therefore, both supportive family behaviors and obstructive family behaviors are included in each model to accommodate suppressor effects (Conger, 1974). All adjusted models also included apriori covariates [age, gender, race (White, Black, or other), education, insurance status (uninsured, public, or private), diabetes duration, and insulin status].

Results

As shown in Table 1, participants were, on average, 51.2 ± 10.6 years old, 57% were African American, and 10% were Hispanic. Only 12% had a college degree and an additional 36% had a high school degree or equivalent. Seventy-one percent had an annual income < \$15,000, and 49% were uninsured. On average, S-TOFHLA scores were 26 ± 10.8 , with 26% ($n=48$) categorized as having limited HL and 74% ($n=135$) categorized as having adequate HL. As shown in Table 1, being non-White or Hispanic was associated with having limited HL. Most participants who preferred Spanish were categorized as having limited HL (10 out of 11; Table 1). Having less education or a lower income was also associated with having limited HL (Table 1).

In unadjusted (Table 1) and adjusted analyses (ANCOVA $F(1, 166)=5.09, p=.025$), participants with limited HL reported more supportive family behaviors (2.8 ± 1.2) than

participants with adequate HL (2.2 ± 0.9). However, HL status was not associated with obstructive family behaviors or HbA_{1C} in unadjusted (Table 1) or adjusted analyses (ANCOVA $F(1, 166) = .99, p = .32$ and $F(1, 169) = .35, p = .56$, respectively). As shown in Table 2, in unadjusted analyses, obstructive and supportive family behaviors each significantly interacted with HL status once we adjusted for the supportive X obstructive interaction (Models 3 & 4). There was no three-way interaction, indicating more supportive family behaviors reduced the association between obstructive family behaviors and HbA_{1C} regardless of HL status.

Once apriori covariates were included in the models, there were no significant interactions between supportive or obstructive family behaviors and HL status (Table 2). This may be due to either (a) the absence of moderation effects when accounting for potential confounders or (b) failure to detect interaction effects (i.e., type II error) due to a low case:control ratio (approximately 1:3 in this case) without a very large sample (Marshall, 2007). Adjusted stratified analyses supported the latter for the HL X obstructive family behaviors interaction; there was a substantive difference between the effect of obstructive family behaviors on HbA_{1C} by HL status after adjusting for the supportive X obstructive interaction and covariates. Figure 1 presents these relationships with adjusted β coefficients for simple slopes stratified by HL status. At low levels of supportive family behaviors, obstructive family behaviors were associated with worse glycemic control and this effect was stronger for participants with limited HL (adjusted simple slopes $\beta = 0.70, p = .05$ versus $\beta = 0.36, p = .009$; Figure 1). However, at high levels of supportive family behaviors there was no association between obstructive family behaviors and HbA_{1C} regardless of HL status (i.e., there was no HL X supportive family behavior interaction; see Figure 1).

Discussion

Patient-centered care includes acknowledging and accommodating patients' HL limitations and involving patients and their families in diabetes management (Envisioning the National Health Care Quality Report, 2001). Our results suggest adults with limited HL are especially vulnerable to the harmful aspects of family involvement in their diabetes management. Although participants with limited HL reported more supportive family behaviors for diabetes self-care than participants with adequate HL, they did not report fewer obstructive family behaviors than participants with adequate HL. Stratified analyses indicated obstructive family behaviors had the strongest relationship with worse glycemic control among patients with both few supportive family behaviors and limited HL, even after adjusting for participants' age, gender, race, education, insurance status, diabetes duration, and insulin status. This relationship was weaker (though still present) among patients with few supportive family behaviors and adequate HL. Supportive family behaviors protected against the detrimental effects of obstructive family behaviors on HbA_{1C} regardless of HL status. Our findings are in contrast to Lee et al.'s (2004) hypothesis that adults with limited HL would benefit more from positive interactions with their social network – we found no association between supportive family behaviors and better HbA_{1C}, regardless of HL status. Our findings are consistent, however, with Lee et al.'s (2004) hypothesis that adults with limited HL would experience stronger detrimental effects of harmful interactions with their social network.

We are the first, to our knowledge, to test either of these hypotheses in a sample of adults with diabetes, and the first to test and find support for the hypothesis that the health status of adults with limited HL may be more vulnerable to harmful interactions with social networks than those with adequate HL in any disease context. In other disease contexts, moderation findings related to positive support and HL have been unexpected (Johnson et al., 2010; Lee et al., 2009). These studies found social support to be more strongly associated with self-reported health status (Lee et al., 2009) and medication adherence (Johnson et al., 2010) among patients with *adequate* HL than among patients with limited HL. Lee et al. (2009) suggest these unexpected findings may be attributed (a) to a lack of differentiation of the type of support being provided and/or (b) to adults with limited HL being embedded in social networks with similar educational backgrounds and/or literacy levels. However, we focused on family member support and specific types of support (i.e., helpful and harmful behaviors). Future research should examine the HL status of family members of patients with limited HL to inform efforts to communicate effectively with family members about the types of behaviors that are helpful and harmful to the patient's diabetes-management. Given the relationships between family members' behaviors and adult patient's glycemic control, future research should explore the effects of family members' HL status as a moderator of these relationships and, in turn, how to accommodate for HL limitations in family-based interventions.

Our finding that adults with limited HL reported more supportive family behaviors, but not more obstructive family behaviors, than those with adequate HL is consistent with other studies in diabetes (Osborn et al., 2010; Rosland et al., 2010). Osborn et al. (2010) found that less HL was associated with more social support, which was, in turn, associated with greater adherence to self-care and glycemic control. Rosland et al. (2010) examined the relationships between HL and family support and family barriers to self-care, which were operationalized similarly to obstructive family behaviors in this study. They, too, reported adults with limited HL had more family support than those with adequate HL but found no differences in family barriers by HL status (Rosland et al., 2010). Although Rosland et al. (2010) did not examine the relationships between these factors and glycemic control, as we've done here, they did identify some potential mediating pathways between family members' behaviors and patients' glycemic control. For instance, reporting family members interfered more with self-care was associated with patients having lower self-efficacy and being less adherent to self-care (Rosland et al., 2010). Future research should explore in what ways patients with limited HL are more vulnerable to obstructive family behaviors. For instance, do such behaviors reduce their self-efficacy for self-care or their actual performance of self-care behaviors over time?

There are several study limitations to acknowledge. First, our cross-sectional data can only speak to associations between variables and not cause and effect. Second, the ratio of limited to adequate HL participants and small sample size may have limited our ability to identify interaction effects with adjusted analyses. Third, our sample was drawn from a single FQHC potentially limiting generalizability, especially to patient populations that are more heterogeneous with respect to SES. Fourth, we categorized participants as having adequate or limited HL on a single objective measure. We also did not screen for visual impairment

before administering the S-TOFHLA, so we cannot ascertain if the eight participants who reported they could not see the S-TOFHLA were concealing HL limitations, requiring we exclude their data from our analyses. Fifth, we were unable to account for the potential role of numeracy in our analyses, as we did not include an objective measure of numeracy in the larger study. Given the established relationships between numeracy and HL (Berkman et al., 2011), and numeracy and glycemic control (Osborn et al., 2009), future work should account for the role of numeracy in the relationships identified here. Sixth, we relied on patients' report of family behaviors. Our measure used categorical responses (e.g., "once a day", "twice a week"), which may be less susceptible to bias by literacy status than scaled responses, but we cannot ensure participants' report of family behaviors were not biased by their literacy status. Finally, although we followed procedures to ensure the DFBC-II was properly translated to Spanish, it has not been validated in Spanish-speaking populations.

Understanding how family members' involvement in diabetes self-care is uniquely associated with the glycemic control of adults with limited HL can help to more effectively develop family interventions for patients with the highest levels of need. In our study, adults with limited HL reported family members performed more diabetes-specific supportive behaviors. However, adults with T2DM and limited HL may be more vulnerable to the negative effects of obstructive family behaviors on their glycemic control than their adequate HL counterparts. The additional supportive family behaviors reported by adults with limited HL appear to protect against the detrimental effects of obstructive behaviors on glycemic control, but more attention to the harmful aspects of family involvement in adults' diabetes management is necessary. Future research should examine these relationships in different patient populations to identify intervention content that effectively reduces obstructive family behaviors and to identify which diabetes-specific supportive family behaviors may be most protective for adults with limited HL. Intervention efforts focused on increasing "social support" or "family support" for diabetes self-care may not be effective unless they also decrease obstructive family behaviors, and this appears especially important for patients with limited HL.

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Figure 1.

Adjusted associations between obstructive family behaviors and patients' glycemic control (HbA_{1c}) in the context of low versus high supportive family behaviors (± 1 SD), stratified by health literacy status. Graphs and simple slopes adjusted for apriori covariates (age, gender, race, insurance status, diabetes duration, and insulin status). ns = not significant; SD = standard deviation.

Table 1

Participant characteristics stratified by health literacy status according to the Short Test of Functional Health Literacy in Adults (S-TOFHLA).

	All participants <i>n</i> = 183 ^a	Health Literacy Status		<i>p</i> ^b
		Limited <i>n</i> = 48	Adequate <i>n</i> = 135	
DEMOGRAPHIC CHARACTERISTICS				
Age, years	51.2 ± 10.6	53.8 ± 11.2	50.3 ± 10.2	.075
Gender				.586
Male	55 (30.0)	16 (33.3)	39 (28.9)	
Female	128 (70.0)	32 (66.7)	96 (71.1)	
Race				<.001
Caucasian/White	59 (32.3)	7 (14.6)	52 (38.5)	
African American/Black	1.4 (56.8)	28 (58.3)	76 (56.3)	
Other race	20 (10.9)	13 (27.1)	7 (5.2)	
Hispanic ethnicity	19 (10.4)	13 (27.1)	6 (4.44)	<.001
Spanish-speaking	11 (6.0)	10 (5.5)	1 (0.5)	<.001
Education, years	12.1 ± 2.9	10 ± 3.4	12.9 ± 2.4	<.001
Income ^c				.030
<\$10,000	72 (42.3)	24 (52.2)	48 (38.7)	
\$10,000 – \$14,999	48 (28.3)	16 (34.8)	32 (25.8)	
\$15,000 – \$19,999	25 (14.7)	2 (4.3)	23 (18.5)	
\$20,000	25 (14.7)	4 (8.7)	21 (16.9)	
Insurance Status				.317
Uninsured	90 (49.2)	24 (50.0)	66 (48.9)	
Public insurance	80 (43.7)	23 (47.9)	57 (42.2)	
Private insurance	13 (7.1)	1 (2.1)	12 (8.9)	
DIABETES CHARACTERISTICS				
Diabetes duration, years	7.5 ± 7.1	7.9 ± 7.9	7.4 ± 6.9	.991
Insulin prescribed	86 (47.0)	22 (45.8)	64 (47.4)	.868
FAMILY BEHAVIORS (DFBC-II)				
Supportive	2.4 ± 1.0	2.8 ± 1.2	2.2 ± 0.9	.004
Obstructive	2.1 ± 0.9	2.3 ± 1.0	2.1 ± 0.9	.186
GLYCEMIC CONTROL				
HbA _{1C} , %	7.9 ± 2.0	7.8 ± 1.0	8.0 ± 2.0	.559
Suboptimal (≥ 7.0%)	115 (62.8)	23 (60.4)	86 (63.7)	
Optimal (<7.0%)	68 (37.2)	19 (39.6)	49 (36.3)	

DFBC-II = Diabetes Family Behavior Checklist-II; HbA_{1C} = point-of-care hemoglobin A1C; M = mean; SD = standard deviation

^aNine participants with missing scores on the Short Test of Functional Health Literacy in Adults were excluded, resulting in *n* = 183.

^bResults of Mann-Whitney U and Fisher's exact tests

^c13 participants did not report their income

Table 2

Results of regression models assessing interactions between health literacy status (HL) and supportive and obstructive family behaviors on participants' glycemic control (HbA_{1C}).

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Unadj. β	Adj. β	Unadj. β	Adj. β	Unadj. β	Adj. β	Unadj. β	Adj. β	Unadj. β	Adj. β
HL $\times$ Supportive	-.16	.00	—	—	-.24*	-.08	—	—	-.17	-.01
HL $\times$ Obstructive	—	—	-.09	.02	—	—	-.25*	-.13	-.12	-.17
Supportive $\times$ Obstructive	—	—	—	—	-.23**	-.22**	-.25**	-.23**	-.23	-.32**
HL $\times$ Supportive $\times$ Obstructive	—	—	—	—	—	—	—	—	-.03	.09

Note: A dash (—) indicates that the interaction term was not tested in the model. Unadjusted models include the interaction term(s), supportive family behaviors, obstructive family behaviors, and HL. Adjusted models also include a priori covariates (age, gender, race, education, insurance status, diabetes duration, and insulin status).

* $p < .05$.

** $p < .01$; β = beta, standardized regression coefficients for interaction terms; HL = health literacy status (0=limited, 1=adequate); Supportive = supportive family behaviors as assessed by the Diabetes Family Behavior Checklist-II supportive subscale; Obstructive = obstructive family behaviors as assessed by the Diabetes Family Behavior Checklist-II nonsupportive subscale.