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Social Integration and Diabetes Management among Rural Older Adults

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Abstract

Objectives—To describe diabetes management behaviors and social integration among older adults, and delineate the associations of social integration with diabetes management behaviors.

Design—Interview data from 563 African American, American Indian and white participants (age 60+) from eight south central North Carolina counties selected using a site-based procedure. Statistical analysis comprises descriptive statistics, bivariate analysis, and multivariate analysis.

Results—Participants had high levels of social integration and largely adhered to diabetes management behaviors (glucose monitoring, checking feet, maintaining diet, formal exercise program, health provider monitoring A1C and examining feet). Social integration was associated with several behaviors; social network size, particularly other relatives seen and spoken with on the telephone, was associated with provider A1C monitoring and foot examinations.

Discussion—Social integration had small but significant associations with diabetes management behaviors. This analysis suggests specific mechanisms for how social integration **influences** the effect of disease on disability.

Keywords

Diabetes management; social integration; social engagement; social network; disablement process

Introduction

Social integration is the means through which people interact, connect, and validate each other within a community (Durkheim, 1897). Older adults with greater social integration have less disability, greater physical functioning, and high levels of cognitive functioning (Glass, Mendes de Leon, Marottoli & Berkman, 1999; Mendes de Leon, Glass, Beckett, Seeman, Evans & Berkman, 1999; Everard, Lach, Fisher & Baum, 2000; Mendes de Leon, Gold, Glass, Kaplan & George, 2001; Mendes de Leon, Glass & Berkman, 2003; Arcury, Chen, Savoca, Anderson, Leng, Bell & Quandt, 2012). Social integration has two major dimensions, social engagement and social network (Glass et al., 1999). Social engagement is

productive social activities, such as working, volunteering, participating in church activities, and participating in social and fraternal organizations. It is an indicator of the quality of social integration. Social network is the number of individuals with whom a person interacts. It is an indicator of the amount of, or opportunity for, social activity. The people in a social network can come from different social domains, including children, relatives, friends, and confidants (Glass, Mendes de Leon, Seeman & Berkman, 1997).

Verbrugge and Jette (1994) suggest that greater social integration is protective of disability and decline in physical and cognitive functioning. General research on social integration among older adults has documented causal associations with disability and cognitive status, as well as with mortality (Glass et al., 1999; Mendes de Leon et al., 1999, 2001, 2003; Everard et al., 2000). This causal association is probably reciprocal, with social isolation causing increased disability, and greater disability leading to greater social isolation (Mendes de Leon et al., 2001, 2003; Verbrugge, Reoma, & Gruber-Baldini, 1994).

Diabetes can initiate the decline leading to disability predicted by Verbrugge and Jette's (1994) disablement process model. Diabetes is a prevalent chronic condition among older adults. Diabetes control is based on a set of behaviors that include such self-management practices as home glucose monitoring, foot care, diet and exercise, and such health provider practices as hemoglobin A1C and regular examination of feet (American Diabetes Association, 2011). Appropriate implementation of these management behaviors can delay disability caused by neuropathy, amputation, and retinopathy and blindness that result from diabetes. However, health and financial barriers can result in older adults having difficulty in accomplishing the advocated diabetes management behaviors. For example, blood glucose monitoring requires that the older adult can afford test strips, is able to obtain a blood sample, can read the monitor, and can interpret the results; maintaining a diet requires that the older adult has access to stores that sell fresh fruits and vegetables and can afford to purchase these foods; exercising requires that the older adult has access to a safe facility and does not have other health conditions that limit physical activity. Following from the disablement process model, those with greater social integration should be better able to accomplish the diabetes management behaviors based on their access to greater help and support. For example, older adults with more frequent interaction with children or friends could call on these individuals for help in obtaining appropriate food, having prescriptions filled, inspecting their feet, or transportation for appointments with health care providers. Similarly, older adults who are more socially engaged will be in situations that support appropriate physical activity.

Much of the research on the associations of social integration with disability and functioning among older adults has been conducted in metropolitan settings (Barnes, Mendes de Leon, Bienias & Evans, 2004a; Barnes, Mendes de Leon, Wilson, Bienias & Evans, 2004b; Glass et al., 1997, 1999; Mendes de Leon et al., 2001). Older adults in rural areas face significant barriers to social integration. These include fewer formal social groups, greater distances between people, less available public transportation, and a history of out-migration that removes children and relatives from the community (Rowles, 1988; Arcury, Preisser, Gesler & Powers, 2005). Consideration of ethnic differences in the association of social integration and disability has also been limited to comparison of African American and white older adults (Barnes et al., 2004a, 2004b; Glass et al., 1997, 1999; Mendes de Leon et al., 2001). Ethnic differences are important to the association of social integration with disability because ethnicity affects the access individuals have to formal social groups, the social networks to which individuals belong, and the number of children and relatives who live in the community.

Minority and rural older adults experience more complications and greater disability with chronic conditions such as diabetes than do minority and urban older adults (Kirk, Bell, Bertoni, Arcury, Quandt, Goff, and Narayan, 2005; Kirk, D'Agostino, Bell, Passmore, Bonds, Karter, and Narayan, 2006; Kirk, Graves, Bell, Hildebrandt, and Narayan, 2007). The level of social integration of minority and rural older adults may account for a portion of these health disparities. The amount of social integration may account for differences in the implementation of management practices, diabetes control, diabetes complications, and disability.

This analysis is based on a multi-ethnic (African American, American Indian, white) sample of older adults with diabetes who reside in rural counties in south central North Carolina. This analysis has two aims. The first aim is to describe diabetes management behaviors and social integration, in terms of both social engagement and social network, among older adults. Ethnic differences in social integration and diabetes management behaviors are also examined. The second aim is to delineate the associations of social integration with diabetes management behaviors.

Methods

Sample

The research was conducted in eight south central North Carolina counties (Harnett, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson and Scotland) in North Carolina. These counties were chosen because they contain large minority populations and because a high proportion of the population is below the federal poverty line. They represent variation on the urban-rural continuum (<http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/2003>). The total sample included 593 African American, American Indian, and white men and women 60 years or older, who had a diabetes diagnosis for at least two years, and were not receiving dialysis treatment. The goal of the sampling plan was to recruit 100 participants for each ethnic/gender cell, with each cell having participants spread across educational attainment categories. Participant recruitment was designed to provide a representative sample.

Participants were recruited from various organizations and locations within each county to represent site-based sampling (Arcury & Quandt, 1999). Study staff members have conducted research in the study counties since 1996 (Quandt, Arcury, Bell, McDonald, and Vitolins, 2001; Quandt, Vitolins, Smith, Tooze, Bell, Davis, DeVellis, and Arcury, 2006). Formal and informal community leaders provided support with study recruitment by introducing the study staff to recruitment locations and by verifying the legitimacy of the research project to elder participants. The number of participants from each type of recruitment location included: 124 from community-based organizations (veteran, civic groups, senior clubs, etc.), 40 from health-related community events, 43 from churches, 13 from flyer postings and public recruitment, 81 from senior housing, and 104 from congregate meal sites. An additional 188 were recruited through social networks of participants (106), community leaders (36), interviewers (22), and lists of past participants in studies that had used site-based sampling (24).

Data Collection

Data collection was completed from June 2009 through February 2010. Each respondent was asked to complete two separate interviews at about one month intervals: 593 participants completed the first interview, and 563 participants completed both the first and second interview resulting in a 95% retention rate. This analysis is limited to participants who completed both interviews. Interviews were completed in participants' homes, unless

they requested otherwise. Interviewers outlined the project objectives and obtained written informed consent. An incentive (\$10) was given for completing each of the interviews. The Wake Forest School of Medicine Institutional Review Board approved all procedures.

Interviews consisted of an interviewer-administered, fixed response questionnaire. The interviews included the personal characteristics age, ethnicity, marital status, employment status, education, income, and diabetes status; diabetes management behaviors; and social engagement and social interaction behaviors.

Measures

Outcome measures were adherence with six diabetes management behaviors (Toobert, Hampson & Glasgow, 2000). Participants indicated if they conducted the self-management behaviors of home glucose monitoring, checking their feet, maintaining a proper diet, and participating in a formal exercise program, as well as the health provider behaviors of A1C monitoring and foot examination. These dichotomous measures were summed to a total diabetes management score that had a potential range of 0 to 6.

Participant personal characteristics included ethnicity (African American, American Indian, white) and gender. Age was grouped into the categories, 60 to 69 years, 70 to 79 years, and 80 years and older. Educational attainment was grouped into the categories less than high school, high school, and more than high school. Economic status was a dichotomous measure of being below poverty or above poverty based on 2007 federal poverty thresholds for household income and size (The 2007 HHS Poverty Guidelines). Migration status had the values of always having lived in the South versus having lived outside the South. Diabetes duration had the values of less than 10 years versus 10 or more years since initial diagnosis. Number of chronic health conditions was a continuous measure based on eight chronic conditions related to diabetes (stroke, heart disease, hypertension, retinopathy, nephropathy, lower extremity amputation, chronic obstructive pulmonary disease, other).

Social integration first included a single measure of social engagement, and four measures of social network: marital status, number of children, primary social network size, and secondary social network size. The measure of social engagement was based on the combination of items indicating participation in productive social activities in four different domains (Barnes et al., 2004a, 2004b; Arcury et al., 2012): senior centers, clubs, church (0 = do not participate, 1 = seldom participate, 2 = often participate); and employment (0 = not employed, 1 = employed part-time, 2 = employed full-time). Compared to Barnes et al. (2004b), museum attendance was replaced with senior center attendance. Senior centers in these communities were important for social engagement; they provided the opportunity to socialize and participate in meals, educational programs, and arts-and-crafts classes. Total values ranged from 0 to 8.

Marital status had the values of currently married versus not currently married. Number of children was a continuous measure. Primary social network size was based on a measure reported by Mendes de Leon, Gold, Glass, Kaplan, and George (2001). Participants reported the number of children (who do not reside with them), other relatives, and friends they interacted with each month. The number of children, other relatives, and friends seen each month was recorded as the actual number and truncated at 10 for those with 10 or more. Total primary social network was the total number of children (truncated at 10), other relatives (truncated at 10), and friends (truncated at 10) with whom the participant interacts each month. Total values ranged from 0 to 30. Secondary network size was a measure of social network breadth, as it included both personal and telephone contact. Similar to primary social network size, secondary network size included the sum of the primary social network plus the number of times the participant spoke on the telephone each week with

children (truncated at 10), relatives (truncated at 10), and friends (truncated at 10). Total values ranged from 0 to 60.

The investigators decided that it was important to consider both primary and secondary social network size because preliminary analyses indicated that each had unique associations with some diabetes management behaviors. Therefore, number of children seen in the past month, number of other relatives seen in the past month, number of friends seen in the past month, number of children telephone contacts in the past week, number of other relative telephone contacts in the past week, and the number friend telephone contacts in the past week are included in the analyses. Each of these measures other than number of telephone contacts in the past week were truncated at 10.

Analysis

Statistical analysis comprises descriptive statistics, bivariate analysis, and multivariate analysis. Chi-square tests were used to test associations between two categorical variables (e.g., whether or not the participant monitored blood glucose level and ethnic group). ANOVA was used to consider associations between a continuous variable (e.g., number of chronic conditions) and categorical variables (e.g., ethnic group). In both cases, p-values were categorized ($<.001$, $<.01$, and $<.05$) to indicate the strength of association. For multivariate analysis, the total diabetes management score was designated as the outcome variable. Three different regression models using different sets of predictor variables were fitted to examine the associations of different components of social integration on the diabetes management score: Model 1 includes primary social network; Model 2 includes secondary social network, which is based on primary social network plus contact via telephone; Model 3 includes the individual components which constitute the primary and secondary network measures. The data analyses were conducted using SAS v9.2 (SAS Inc., Cary, NC).

Results

Personal Characteristics

The majority of the participants were female (61.8%) (Table 1). Somewhat more than half (51.5%) were aged 60 to 69 years, with 37.1% being aged 70 to 79 years, and 10.8% being aged 80 years and older. About one-third (36.5%) of the participants had less than a high school education, with one third (37.7%) having a high school education and 29.9% having education beyond high school. Almost one-third (30.5%) of the participants had incomes below poverty. About 6-in-10 participants had had diabetes for ten or more years. Participants had an average of 1.8 chronic conditions in addition to diabetes.

Participants differed in most of the personal characteristics by ethnicity. A greater percent of American Indian participants were female (71.4%) compared to African American (57.4%) and white (58.0%) participants. American Indian participants were younger, with 58.3% being aged 60 to 69, compared to 45.3% of African American and 51.7% of white participants; a greater percentage of white participants (16.1%) were aged 80 years and older compared to African American (9.0%) and American Indian (6.6%) participants. American Indian participants had lower educational attainment, 44.6% had less than high school education, compared to 38.1% of African American and 28.3% of white participants; a greater percentage of white participants (36.6%) had more than high school education compared to African American (28.6%) and American Indian (23.2%) participants. More American Indian participants (74.4%) had always lived in the South than African American (59.0%) or white participants (67.3%). Participants did not differ in economic status, diabetes duration or number of chronic conditions by ethnicity.

Diabetes Management Behaviors

The majority of participants engaged in most of the diabetes management behaviors (Table 2). Most participants reported monitoring their glucose (79.0%), taking care of their feet (79.6%), and maintaining their diet (53.3%). Providers monitored A1C (90.1%) and examined feet (80.4%) for most participants. However, only 18.2% of participants were in an exercise program. The mean number of diabetes management behaviors among participants was 3.9. Participants did not differ by ethnicity in any of diabetes management behaviors.

Social Integration

The mean social engagement score was 2.7 (SD = 1.7). Fewer than half (46.4%) of participants were currently married (Table 3). They had a mean of 3.4 children. The mean primary social network size was 19.8 (SD = 8.3). On average, participants saw a child 6.4 times per month (SD = 4.3), another relative 6.9 times per month (SD = 4.0), and a friend or neighbor 6.5 times per month (SD = 4.2). The mean secondary social network size was 35.0 (SD = 13.6). They spoke on the telephone with a child 5.7 times per week, another relative 5.1 times per week, and a friend 5.1 times per week.

Social engagement did not differ by ethnicity. However, participants differed by ethnicity for several of the social network indicators. More white participants (52.7%) were currently married than African American (39.0%) or American Indian (47.0%) participants. African American participants had more children (3.7) than did American Indian (3.3) or white (3.2) participants. Primary social network size was greater for American Indian participants (22.0) than for African American (19.9) or white (18.0) participants. American Indian participants saw more children (7.5) and other relatives (8.0) each month than did African American (6.0 and 7.4, respectively) or white (5.8 and 5.6, respectively) participants. Secondary social network size was also greater for American Indian participants (38.6) than for African American (35.7) or white (31.3) participants. American Indian participants spoke on the telephone with children (6.7) and other relatives (6.1) more frequently each week than did African American (5.5 and 5.6, respectively) or white (5.2 and 3.8, respectively) participants.

Personal Characteristics and Diabetes Management Behaviors

Participant personal characteristics were not consistently associated with the diabetes management behaviors (Table 4). More females (84.1%) than males (70.3%) monitored their glucose; more males (21.8%) than females (16.1%) were engaged in an exercise program. Females had a higher total diabetes management behavior score (3.8) than males (3.5). Age was related to total diabetes management behavior score, with those aged 60 to 69 years having a score of 3.6, those aged 70 to 79 years having a score of 3.8, and those aged 80 years and older having a score of 3.9. Education was not associated with any diabetes management behaviors. More of those below poverty monitored their blood glucose than those above poverty (84.9% versus 76.5%). Always living in the South was not associated with any diabetes management behaviors. More of those with diabetes duration of 10 years or more monitored their glucose than those who had had diabetes for less than 10 years (81.8% versus 73.5%); more of those with diabetes duration of 10 or more years practiced foot care (83.2% versus 73.8%). More of those with diabetes for less than 10 years participated in an exercise program (24.9% versus 13.9%). Number of chronic conditions was not associated with any diabetes management behaviors. None of the participant personal characteristics were associated with diet or with the provider A1C monitoring or foot examinations.

Social Integration and Diabetes Management Behaviors

Social integration was more consistently associated with health provider diabetes practices than with self-management behaviors (Table 5). Those monitoring their glucose were less socially engaged (2.6) than those not monitoring their glucose (3.1). Fewer of those currently married monitored their glucose (73.0%), than those who were not currently married (84.0%). Those practicing foot care had more children (3.6) than those not practicing foot care (2.8). Those without provider A1C monitoring and foot examination had more children (4.3 and 3.9, respectively), than those with provider A1C monitoring and foot examination (3.3 for both). Those with provider A1C monitoring had larger primary social networks (20.2) those without provider A1C monitoring (17.1). Primary social network size was positively associated with total diabetes management behavior score. Those with provider A1C monitoring had larger secondary social networks (35.7) than those without provider A1C monitoring (30.7). Those with provider foot examinations had larger secondary social networks (35.6) those without provider foot examinations (32.4). Secondary social network size is positively associated with total diabetes management behavior score.

Examination of the components of social network size indicated that the number of children seen each month and number children telephoned each week were not associated with diabetes management behaviors. However, the number of other relatives seen each month and the number of other relatives spoken with on the telephone each week were associated with diabetes management behaviors. The mean number of relatives seen each month was greater among those whose provider monitored their A1C (7.1) than among those whose provider did not (5.8). The total diabetes management score was positively associated with number of other relatives seen each month. The mean number of relatives spoken with on the telephone was greater among those whose provider monitored their A1C (5.3) and provided foot examinations (5.4), those whose provider did not (3.9 and 4.0, respectively). The total diabetes management score was positively associated with the number of other relatives spoken with on the telephone.

Diabetes Management Behaviors: Personal Characteristics and Social Integration

Multivariate analyses that included personal characteristics and measures of social integration indicated that secondary network size, particularly the number of other relatives spoken with on the telephone, had a small but significant association with total diabetes management score (Table 6). In Model 1, none of the social integration measures, social engagement, marital status, number of children, and primary network size, had a significant association with the total diabetes management score. However, the personal characteristics of being female and increasing age were associated with the total diabetes management score.

In Model 2, secondary social network size had a small, but significant association with total diabetes management score. American Indians compared to whites had a worse total diabetes management score, while being female and increasing age were associated with the total diabetes management score. In Model 3, other relatives spoken with on the telephone had a small, but significant association with total diabetes management score. American Indians compared to whites had a worse total diabetes management score, while increasing age were associated with the total diabetes management score.

Discussion

The older adults aged 60 and older who participated in this study had high levels of social integration. They were similar in the percent married, but had a higher level of social

engagement and larger primary and secondary social networks when compared to the social integration of adults 65 and older in the same region of North Carolina described in an analysis by Arcury and colleagues (2012). Differences by ethnic group for older adults in the current analysis and that of Arcury and colleagues (2012) in marital status, social engagement, and social network size were similar. For both, a greater percentage of white older adults compared to African American and American Indian older adults were married, with greater levels of social engagement among African American and American Indian compared to white older adults, and with larger primary and secondary social networks among American Indian compared to African American and white older adults. The white older adult participants in this study had similar levels of social engagement and social network size when compared with primarily white urban samples of older adults (Barnes et al., 2004a; Mendes de Leon, et al., 2001). However, all participants and the African American participants in this analysis had greater levels of social engagement and larger social networks than those reported for these primarily urban samples of older adults.

Differences between the results for these rural participants and the urban samples may reflect several factors. First, the measure of social engagement used in this analysis differed in one component from that used by earlier studies. Whereas Barnes and colleagues (2004a) and Mendes de Leon and colleagues (2001) included visiting a museum as component of social integration, the measure for this analysis is based on participant in a senior center. It is likely that senior center participation is more common than visiting a museum, even among urban residents. Second, the residents of the study counties are generally conservative Christians who attend church frequently (Arcury, Quandt, McDonald & Bell, 2000; Arcury, Stafford, Bell, Smith, Snively & Quandt, 2007); this may have increased the church participation component of the social engagement measure. Third, the members of these rural communities reflect the *gemeinschaften* sentiment that places more importance on strong personal relationships than does the more urban *gesellschaften* sentiment (Tönnies, 1887); this may have resulted in larger social networks. Finally, the availability and use of telephones, particularly cell phones, has grown over the past several decades, even in rural communities; this may also have resulted in an increased number of contacts and a large measure of secondary network size.

Differences by ethnicity in social network size among the participants may reflect differences in gender, age, and education by ethnicity. However, these demographic characteristics were included in the multivariate models examining the associations of social integration and diabetes management score.

The percentage of older adults engaged in the diabetes management behaviors did not differ by ethnicity among the participants. This differs from other research that has documented greater adherence of diabetes management behaviors among white adults compared to minority adults (Kirk et al., 2005, 2007). The results in this study may reflect a sample of older adults who all live in the same area of one state. The counties in this area have limited health care options, and they have high rates of poverty. The residents of these counties share a common history and experiences with the health care system that may equalize diabetes related behaviors across ethnic groups.

Even with the high level of adherence to these diabetes management behaviors, levels of social integration were associated with several of the behaviors. This was particularly the case for provider A1C monitoring and provider foot examinations. The total diabetes management score was associated with specific measures of social network size in each of the multivariate models. In the bivariate analysis, measure so social network size, particularly other relatives seen each month and other relatives spoken with on the telephone

in the past week were associated with provider A1C monitoring and provider foot examinations.

This analysis shows that social integration had small but significant associations with diabetes management behaviors, but the pattern of these associations was not as expected. Social integration had little association with the self-management behaviors of home glucose monitoring, checking their feet, maintaining a proper diet, and participating in a formal exercise program. It is with these self-management behaviors that the greatest association of social integration was expected. Being married, having more children, being more socially engaged, and having larger social networks was expected to result in more support for the self-management behaviors. However, few associations between the social integration measures and the diabetes self-management behaviors were significant.

The social integration measures, particularly the size of the secondary social network, were associated with the provider practices of A1C monitoring and foot examination. This was not expected. Even more interesting, interaction with children was not the important component of social network associated with greater adherence to these behaviors. In fact, those who did not adhere to these provider behaviors had a larger number of children (mean of 4.3 children for those not adhering to provider A1C monitoring; mean of 3.2 children for those not adhering to provider foot examination) than those who did adhere to these behaviors (mean of 3.3 children for those adhering to provider A1C monitoring; mean of 2.5 children for those adhering to provider foot examination). Number of children spoken with on the phone each week was not associated with any of the diabetes management behaviors, while number of other relatives spoken with on the phone each week was associated with provider A1C monitoring and provider foot examination, as well as participating in an exercise program and the total diabetes management score.

Fiori, Antonucci, and Corina (2006) found that lacking friends was more detrimental than lacking family for mental health. Their measure of family was limited to contact children, and it is therefore likely that their measure of contact with friends include other relatives. The current analysis did not ascertain the kinship categories of other relatives, but, as these are older adults whose parents are likely deceased, these other relatives are probably siblings and cousins who may undergo the same medical or self-management tasks. Individuals with similar life experiences or chronic illnesses may share knowledge and experience that others, including their children, cannot offer or understand. This may indicate that discussion and advice from peers or relatives of the same generation is more important for adhering to health management behaviors than is advice received from children.

This analysis expands insight into the role of social integration in shaping the disablement process in the context of chronic disease such as diabetes. It considers the association of components of social integration on the practice of the actual behaviors known to be important in delaying disease complications and disability in diabetes. Other analyses of the role of social integration have not examined such proximal factors between disease and disability. Earlier analyses have consider the associations of social integration on outcomes such as general measures of morbidity and mortality (Glass et al., 1999), general disability (Mendes de Leon et al., 1999, 2001, 2003), and cognitive decline, physiological well-being, and mental health (Barnes et al., 2004b; Greenfield & Marks, 2007; Fiori et al., 2006; Hao, 2008). Arcury and colleagues (2012) have shown that social integration is related to oral health among older adults. However, this is one of the few analyses that address the actual mechanism of how social integration may translate into behaviors that **influence** the effect of disease on disability as predicted by the disablement process model (Verbrugge & Jette, 1994; Verbrugge et al., 1994).

This analysis should be evaluated in light of its limitations. The research used a cross-sectional design; therefore, causality can only be inferred. The sample was not randomly selected. Given the site-based approach used for recruitment, the high level of social integration among the participants may be related to their willingness and ability to participate in this study. Participation was limited to older adults from eight rural counties in a single state, so the results may not be generalizable. Finally, the diabetes management behaviors were measured by self report which may affect the validity of these measures. However, the study also has several strengths. It is conceptually based. The sample is relatively large. The measures of social integration and social network are based on the existing literature. The analysis explores the different components of social network.

This analysis found that older adults had both high levels of social integration and adherence to diabetes management behaviors. Several indicators of social integration, particularly secondary social network size and specifically interaction with other relatives, were associated with adherence to diabetes management behaviors. This research documents the manner in which social integration may **influence** the process from disease to disability. Further research is needed to delineate the role older relatives may play in adherence to health management behaviors. Same generation relatives may be an important channel for supporting the health behaviors of other older adults.

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Table 1

Sample Personal Characteristics by Participant Ethnicity, Older Adults in East Central North Carolina

Personal Characteristics	Total Sample (n=563)		African American (n=190)		American Indian (n=168)		White (n=205)	
	n	%	n	%	n	%	n	%
Gender ^b								
Male	215	38.2	81	42.6	48	28.6	86	42.0
Female	348	61.8	109	57.4	120	71.4	119	58.0
Age ^b								
60 to 69 years	290	51.5	86	45.3	98	58.3	106	51.7
70 to 79 years	212	37.7	87	45.8	59	35.1	66	32.2
80 years or older	61	10.8	17	9.0	11	6.6	33	16.1
Education ^c								
Less than high school	205	36.5	72	38.1	75	44.6	58	28.3
High school	189	33.6	63	33.3	54	32.1	72	35.1
More than high school	168	29.9	54	28.6	39	23.2	75	36.6
Economic Status								
Below poverty	169	30.5	66	35.9	51	30.5	52	25.6
Above poverty	385	69.5	118	64.1	116	69.5	151	74.4
Always lived in South ^a								
Yes	386	68.9	111	59.0	137	82.0	138	67.3
No	174	31.1	77	41.0	30	18.0	67	32.7
Diabetes Duration								
Less than 10 years	211	39.2	66	36.5	78	40.6	67	40.4
10 or more years	328	60.9	115	63.5	114	59.4	99	59.6
Number of Chronic Conditions	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	1.8	1.3	1.6	1.3	1.8	1.3	1.9	1.4

Comparison by Ethnic Group

^a p < .001;^b p < 0.01;^c p < 0.05

Table 2

Diabetes Management Behaviors by Participant Ethnicity, Older Adults in East Central North Carolina

Diabetes Management Behaviors	Total Sample (n=563)		African American (n=190)		American Indian (n=168)		White (n=205)	
	n	%	n	%	n	%	n	%
Glucose Monitoring	428	79.0	145	80.6	129	80.1	154	76.6
Foot Care	414	79.6	148	83.1	124	80.0	142	75.9
Diet	299	53.3	101	53.4	84	50.3	114	55.6
Exercise Program	101	18.2	39	21.2	22	13.3	40	19.5
Provider A1C Monitoring	499	90.1	167	90.3	149	90.3	183	89.7
Provider Foot Examination	450	80.4	153	81.0	132	79.0	165	80.9
Diabetes Management Score	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	3.9	1.2	3.9	1.2	4.0	1.1	3.8	1.1

Comparison by Ethnic Group

^a
p < .001;^b
p < 0.01;^c
p < 0.05

Table 3

Social Integration by Participant Ethnicity, Older Adults in East Central North Carolina

Social Integration	Total Sample (n=563)	African American (n=190)	American Indian (n=168)	White (n=205)
Social Engagement				
Mean	2.7	2.8	2.8	2.6
SD	1.7	1.7	1.7	1.6
Currently Married ^c				
N	261	74	79	108
Percent	46.4	39.0	47.0	52.7
Number of Children ^a				
Mean	3.4	3.7	3.3	3.2
SD	2.5	2.9	2.3	2.3
Primary Social Network Size ^a				
Mean	19.8	19.9	22.0	18.0
SD	8.3	8.2	7.2	8.8
Children Seen Each Month ^a				
Mean	6.4	6.0	7.5	5.8
SD	4.3	4.4	3.9	4.3
Other Relatives Seen Each Month ^a				
Mean	6.9	7.4	8.0	5.6
SD	4.0	3.7	3.4	4.3
Friends Seen each Month				
Mean	6.5	6.51	6.5	6.5
SD	4.2	4.2	4.1	3
Secondary Social Network Size ^a				
Mean	35.0	35.7	38.6	31.3
SD	13.6	13.4	11.8	14.3
Children Spoken with on the Telephone Each Week ^b				
Mean	5.7	5.5	6.7	5.2
SD	4.0	4.1	3.9	4.0
Other Relatives Spoken with on the Telephone Each Week ^a				
Mean	5.1	5.6	6.1	3.8
SD	3.8	3.9	3.5	3.7
Friends Spoken with on the Telephone Each Week				
Mean	4.3	4.7	3.9	4.3
SD	3.9	4.0	3.8	3.9

Comparison by Ethnic Group

^a p < .001;^b p < 0.01;

^c
 $p < 0.05$

Table 4

Associations of Personal Characteristics with Adherence to Diabetes Management Behaviors, Older Adults in East Central North Carolina

	Glucose Monitoring		Foot Care		Diet		Exercise Program		Provider A1C Monitoring		Provider Foot Examination		Diabetes Management Score	
	n	%	n	%	n	%	n	%	n	%	n	%	mean	SD
Gender														
Male	142	70.3 ^c	152	77.7	104	48.8	46	21.8	190	89.6	165	77.5	3.7	1.1 ^b
Female	286	84.1	262	80.9	195	56.0	55	160	309	90.4	285	82.1	4.0	1.0
Age														
60 to 69 years	211	75.9	214	78.7	141	49.0	51	17.7	251	87.8	229	79.5	3.8	1.2 ^c
70 to 79 years	165	80.9	158	81.9	120	56.6	35	16.9	191	91.8	171	81.0	4.0	1.1
80 years or older	52	86.7	42	76.4	38	62.3	15	25.0	57	95.0	50	82.0	4.2	1.1
Education														
Less than high school	159	81.1	151	80.8	97	47.6	29	14.2	173	87.4	159	78.7	3.8	1.2
High school graduate	150	81.5	137	79.7	106	56.1	35	18.8	174	93.1	151	79.9	4.0	1.1
More than high school	118	73.3	125	78.1	96	57.5	37	22.6	151	89.9	139	82.7	4.0	1.2
Economic Status														
Below poverty	135	84.9 ^c	121	79.1	81	48.2	31	18.7	148	90.2	137	81.1	3.9	1.1
Above the poverty	286	76.5	286	79.4	211	55.0	66	17.4	344	90.3	306	80.1	3.9	1.2
Always lived in South														
Yes	292	78.5	279	78.6	200	52.0	62	16.3	342	89.8	306	79.7	3.8	1.2
No	135	80.8	133	82.1	98	56.7	38	22.1	155	91.2	143	82.7	4.0	1.2
Diabetes Duration														
Less than 10 years	147	73.5 ^c	140	73.7 ^b	126	60.0	52	24.9 ^b	184	88.5	169	80.9	3.9	1.3
10 or more years	261	81.8	257	83.2	162	49.5	45	13.9	293	90.4	261	79.8	3.9	1.1
Number of Chronic Conditions	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	coeff	
Yes	1.8	1.34	1.8	1.37	1.7	1.3	1.8	1.38	1.7	1.3	1.8	1.3	0.003	
No	1.7	1.39	1.8	1.19	1.9	1.4	1.8	1.33	2.0	1.4	1.7	1.3		

^a p < .001;

$50'0 > d$
 $50'0 > d$
 $50'0 > d$
 $50'0 > d$

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	Glucose Monitoring		Foot Care		Diet		Exercise Program		Provider A1C Monitoring		Provider Foot Examination		Diabetes Management Scores	
Not Adherent	34.4	14.0	34.7	14.0	34.0	13.8	34.7	13.4	30.7	11.9	32.4	14.3		
Children Spoken with on the Telephone Each Week														
Adherent	5.9	4.0	6.0	4.0	6.0	3.9	5.5	4.1	5.8	4.0	5.8	4.0		0.09
Not Adherent	5.7	4.1	5.5	4.1	5.5	4.1	5.8	4.0	5.5	4.2	5.5	4.2		
Other Relatives Spoken with on the Telephone Each Week														
Adherent	5.3	3.8	5.3	3.8	5.3	3.8	6.0	4.0 ^c	5.3	3.8 ^b	5.4	3.8 ^b		0.22 ^a
Not Adherent	4.8	3.8	5.0	3.7	4.9	3.9	5.0	3.7	3.9	3.6	4.0	3.5		
Friends Spoken with on the Telephone Each Week														
Adherent	4.3	4.0	4.2	3.8	4.4	3.9	5.0	4.2	4.4	3.9	4.38	3.9		0.05
Not Adherent	4.4	3.7	4.6	4.1	4.2	3.9	4.2	3.8	4.2	3.9	3.9	3.8		

^a p < .001;

^b p < 0.01;

^c p < 0.05

Table 6

Multivariate Analysis of Social Integration with Diabetes Management Score, Older Adults in East Central North Carolina

	Model 1		Model 2		Model 3	
	Estimate	SE	Estimate	SE	Estimate	SE
Social Integration						
Social Engagement	−0.01	0.03	−0.02	0.03		
Marital Status						
(Not married)						
Currently married	−0.01	0.11	−0.03	0.11	−0.05	0.11
Number of Children	−0.02	0.02	−0.02	0.02	−0.01	0.02
Primary Network Size	0.01	0.01				
Secondary Network Size			0.01	0.00 ^a		
Children Seen					−0.00	0.01
Other Relatives Seen					−0.00	0.01
Friends and Neighbors Seen					0.01	0.01
Children Telephone					0.01	0.01
Other Relatives Telephone					0.07	0.02 ^a
Friends and Neighbors Telephone					−0.01	0.01
Personal Characteristics						
Ethnicity						
African American	0.02	0.12	−0.01	0.12	−0.09	0.12
American Indian	−0.18	0.13	−0.22	0.13	−0.27	0.12 ^c
(White)						
Gender						
Female	0.31	0.11 ^b	0.26	0.11 ^c	0.16	0.11
(Male)						
Age	0.02	0.01 ^b	0.02	0.01 ^b	0.2	0.01 ^b
Diabetes Duration						
Less than 10 years	−0.01	0.10	−0.01	0.10	−0.00	0.10
(10 or more years)						
Intercept	2.27	0.55 ^a	2.13	0.55 ^a	2.13	0.54 ^a
R ²	0.04		0.06		0.09	

^a p < .001;

^b p < 0.01;

^c p < 0.05