2023

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Submitted to the graduate faculty of The University of Alabama at Birmingham,
in partial fulfillment of the requirements for the degree of
Master of Arts

BIRMINGHAM, ALABAMA

2023

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DEVELOPMENTAL PSYCHOLOGY

ABSTRACT

Diabetes mellitus is one of the most common chronic diseases among older adults, affecting all aspects of daily living including restricted life space mobility, driving and building relationships outside of the home. The aim of this study was to investigate the covariate-adjusted associations of cognitive functioning, depressive symptoms, amount of support received and satisfaction with support with life space mobility, driving frequency and driving exposure among Blacks/African Americans and Whites with diabetes. The study used a representative sample of 247 older adults aged 65 and above from the University of Alabama at Birmingham (UAB) Diabetes and Aging Study of Health (DASH). Average age was 73, 45% of the sample were Black/African American, 53% were female, and 47% were married. Results from multiple covariate-adjusted regression analyses revealed that being Black/African American, older, female, and higher depressive symptoms were associated lower life space mobility, less driving frequency and less driving exposure (all p's $< .05$) while being married, educated, and reporting better health significantly were associated with greater life space mobility. Similarly, higher cognitive function and lower depressive symptoms was associated with greater life space mobility, more driving frequency and more driving exposure. The amount of support received and satisfaction with support were not associated with any of the outcomes, however, greater amount of support received was associated with less driving frequency. The association between cognitive function and driving exposure was stronger for older adults with lower depressive symptoms. Findings from this investigation identify individuals who are at risk for restricted mobility outcomes. Establishing these associations within a health disparities framework would be important as it would draw attention to functioning in later life for racial and socially disadvantaged groups and help inform interventions.

Keywords: diabetes, depressive symptoms, social support, life space mobility, driving frequency, driving exposure.

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INTRODUCTION

For the first time in history, societies across the world are experiencing extraordinary transition in longevity. The population of persons aged 60 and above is increasing more rapidly than all other age groups. This is a result of demographic transition from patterns of high mortality rates to delayed mortality, longer life expectancy, and improved medication and treatment options (United Nations, 2019). According to the Center for Disease Control (CDC), These factors combined with high fertility in many countries during and after World War II has resulted in increased numbers of persons aged 65 and older (Baby Boomers) during 2010 – 2030 (CDC, 2022). In 2019, there were 703 million persons aged 65 years and over and these number is projected to double to 1.5 billion in 2050 (United Nations Ageing, 2020). While every nation across the world today is experiencing rapid population growth in the number of older persons, the trends are not the same across countries. In the United States, population is expected to increase and much of this is due to the baby boom generation moving into the ranks of the 65 and over population (Vespa, Armstrong & Medina, 2020). The number of people aged 65 and older has increased since the 1960s and projected to increase to 98 million by 2060 and crossing the 400 million thresholds in 2058 (U.S. Census Bureau., 2020). It is also expected that the racial and ethnic composition of the older population will change, and Black/African American and Hispanic population will increase more than White.

The rapid increase in aging population has become a success story and marked the most remarkable changes in demography today. It has become one of the contributors to societal transformations with significant implications for governments, agencies, and families.

Incidence of diabetes

While population aging is marked by increasing average life expectancy at older ages, this may not reflect the number of years lived in good health (U.S. Census Bureau, 2021). Recent debate centers on answering whether the extra years are lived in full health without diseases, disabilities, or injuries. However, population aging has presented challenges such as decline in physical and mental capacities, limitations on activities of daily living and increased risk for chronic degenerative diseases (Bloom, Canning, & Lubet, 2015). As people age, they are also likely to have one or more chronic conditions (Centers for Medicare & Medicaid Services, 2019a) with the most common conditions being cancer, heart disease, arthritis, Alzheimer's disease, stroke, and diabetes (Ajuwon & Love, 2020).

Diabetes is one of the fastest growing common chronic diseases causing life threatening, disabling complications, and reducing life expectancy (Heald et al, 2020). The global prevalence of diabetes estimated by the 10th edition of IDF Diabetes Atlas in 2021 was 537 million people with future projections suggesting that by 2045, the absolute number of people living with diabetes will increase by 46%, with the greatest absolute growth (Sun et al., 2022). Clinically, DM is a condition caused by issues with insulin production by the pancreas or resistance by end-organ tissues which later presents as a high blood glucose or elevated glycosylated hemoglobin A_1C (Glovaci, Fan &Wong,

2019). Type 1, type 2 and gestational diabetes are the three types of DM. However, type 2 DM is the most common form, occurring among older adults and accounts for 90–95% of diagnosed DM and continues to be rapidly growing worldwide and in the USA (CDC, 2014).

A recent study by Xue and colleagues (2017) revealed that half of new diagnoses of DM are made in people aged 60 and above. Approximately 25-30% of adults over 65 years have diabetes (American Diabetes Association 2018). The rates of hospital admissions in patients with diabetes are also higher compared with individuals without diabetes. Results from the National Hospital Discharge Survey (NHDS) estimated that about 250,000 hospitalized patients had diabetes as a first-listed diagnosis in 2010, with three times higher rate for individuals aged 65 years and older (48.9 per 10,000 population (CDC, 2010).

Health disparities in Diabetes

Although Americans are living longer than their parents' generation, they are more likely to be diagnosed with chronic diseases including diabetes than their previous generations at the similar ages (Scommegna, 2015). Similarly, health status and access to health care differ among racial, ethnic, geographical, and socioeconomic groups. Previous research has demonstrated that, in the U.S., diabetes affects racial and ethnic minority and low-income adult populations disproportionately, with relatively intractable patterns seen in these populations' higher risk of diabetes and rates of diabetes complications and mortality (Golden, et al., 2012).

Racial Disparities in Diabetes

The percentage of U.S. adults diagnosed with diabetes among non-Hispanic Blacks is 12.1% which is nearly twice that of non-Hispanic Whites (7.4%) (CDC, 2018). Older adults with diabetes, primarily those who belong to racial minorities, are more likely to need hospitalization, however, have limited access to health and healthcare (Zhou, et. al., 2019). Blacks/African Americans are among the groups that have a lower likelihood of receiving treatment for diabetes even though they share a disproportionately high burden of diabetes and related complications such as diabetes distress compared to non-Hispanic White adults (Zhou, et. al., 2019). Several studies have shown that individuals from minority groups are at greater risk of poor outcomes including diabetes related outcomes. A study by Golden (2012) found that Blacks, Native Americans and Alaskan Natives, and Hispanics show 2.3, 1.9- and 1.5-times greater mortality related to diabetes, respectively, compared to their White counterparts. Also, racial minorities, especially Hispanics and Blacks exhibit increased rates of diabetes-related chronic kidney disease (CKD) compared to whites. Another study by Karter et. al., (2017) evaluated race/ethnic differences in the trends in rates of severe hypoglycemia (SH) in a population of insured, at-risk adults with diabetes. Over a 7-year observation period, results showed that African Americans had consistently higher SH rates compared with Whites in each of the 7 years. In a study by Sinha and colleagues, Hispanics and African Americans with diabetes had higher prevalence of early CKD and systemic inflammatory markers compared to whites and evidence showed that Blacks experience more rapid declines in renal function compared to whites once they develop proteinuria (having protein in your urine) (Sinha, Shaheen, Rajavashisth, Pan, & Nicholas, 2014). Efforts to reduce these disparities are needed in maintaining high quality of life among older adults. To address the health needs of older adults, it is important to understand the association between factors that predict disparities among older adults with diabetes.

Income and Educational Disparities in Diabetes

Income and educational levels show a significant association with diabetes prevalence and complications. Older adults with lower levels of income and education are more likely to develop type 2 DM, experience more complications, and die sooner than those higher up on the SES ladder (Agardh, Allebeck, Hallqvist, Moradi, & Sidorchuk, 2011; Brown, Ettner, Piette, Weinberger, Gregg, Shapiro, & Beckles, 2004). The Center for Disease Control and Prevention (2017) reported that diabetes prevalence in the adult U.S. population is inversely associated with educational level. The age-adjusted prevalence of diagnosed diabetes is 12.6% for those with less than a high school education, 9.5% for those with a high school education, and 7.2% for those with more than a high school education. Compared with adults with a college degree or higher, having less than high school education is associated with a twofold higher mortality from diabetes. Similarly, the higher a person's income, the greater their educational attainment, and the higher their occupational grade, the less likely they are to develop type 2 DM or to experience its complications (Hill-Briggs, 2021). Using the National Health Interview Survey (NHIS) data covering 2011–2014, Beckles and Chou (2016) found increasing diabetes prevalence among individuals with lower levels of income, and this reflected in their levels of ratio of income to poverty level. In addition, they found that there was relative percentage difference in prevalence of diabetes for those classified as middle income (40.0%), near poor (74.1%), and poor (100.4%), compared with those with high income. The difference in diabetes prevalence by income was greater during this period than it had been in a prior period (1999–2002), pointing to widening disparities in diabetes prevalence associated with income.

At the federal level, Saydah & Lochner (2010) found in their study that adults with type 2 DM who have a family income below the federal poverty level have a twofold higher risk of diabetes-related mortality compared with their counterparts in the highest family income levels. In another study, Gaskin et al., (2014) examined how individual poverty and community/neighborhood poverty interact to increase the prevalence and outcomes of diabetes. They found that poor adults living in nonpoor neighborhoods have increased odds of having diabetes, and poor adults living in poor neighborhoods have twofold higher odds of having diabetes, compared with nonpoor adults living in nonpoor neighborhoods (Gaskin et al., 2014). Gaskin and colleagues also observed a race-poverty-place gradient. Compared with nonpoor Whites in nonpoor neighborhoods, odds of diabetes were highest for poor Whites in poor neighborhoods (odds ratio [OR] 2.51, 95% CI = 1.31–4.81), followed by poor Blacks in poor neighborhoods and nonpoor Blacks in poor neighborhoods (OR 2.45, 95% CI 1.50–4.01, and OR 2.49, 95% CI 1.48–4.19), and finally poor Whites in nonpoor neighborhoods (OR 1.73, 95% CI 1.16–2.57; Gaskin et al., 2014).

What is Mobility and how is it measured?

Mobility is an individual's ability to move independently or using assistive devices from one point to another within their home and community (Webber, Porter & Menec, 2010). Physical mobility is an extremely important component of physical functioning since it affects all aspects of daily living. As we age, our ability to maintain physical mobility becomes even more critical to successful aging (Johnson, Rodriguez, & Snih, 2020). However, the aging process may cause changes such as reduced muscle mass which may impact the balance and functional mobility of older adults, contributing to increase risk of falls and fracture (Fernando, 2009). Mobility assessment has been tackled in several different ways. May, Nayak, and Isaacs in 1985 introduced the 'life-space diary' to assess older adults' mobility at home. The diary was the first to measure Life-Space Mobility as a concept. Although the life-space diary did not gain widespread use in research, the concept proved accessible and adaptable in later, newer instruments, serving as a foundation for current framework used to address research-related questions in mobility.

The Nursing Home Life-Space Diameter (NHLSD) instrument

In 1990, Tinetti and Ginter developed the Nursing Home Life-Space Diameter (NHLSD) instrument, which focused on institutionalized patients in a long-term care setting (Tinetti & Ginter, 1990). The NHLSD separated a patient's living area into four spaces: their room, outside the room but within the unit, outside the unit but within the facility, and outside the facility. Using 398 residents from 3 nursing homes in New Haven, Connecticut, the NHLSD measured movement over a two-week period with a test-retest reliability of 0.92. Subsequent studies have focused on approach that assess an individual’s ability to perform activities of daily living such as eating, dressing, bathing, and toileting as well as instrumental activities of daily living such as attending social gathering and even shopping (Stalvey, Owsley, Sloane & Ball, 1999). These activities reflect physical functions that are primarily needed in the home. Again, other studies have evaluated methods that assess self-care and enhance functional independence such as postural stability, stairs climbing and gait assessment which are useful in preventing adverse outcomes such as falls in older adults (Cummings et al., 1995; Ettinger, 1994; Tinetti, 1986).

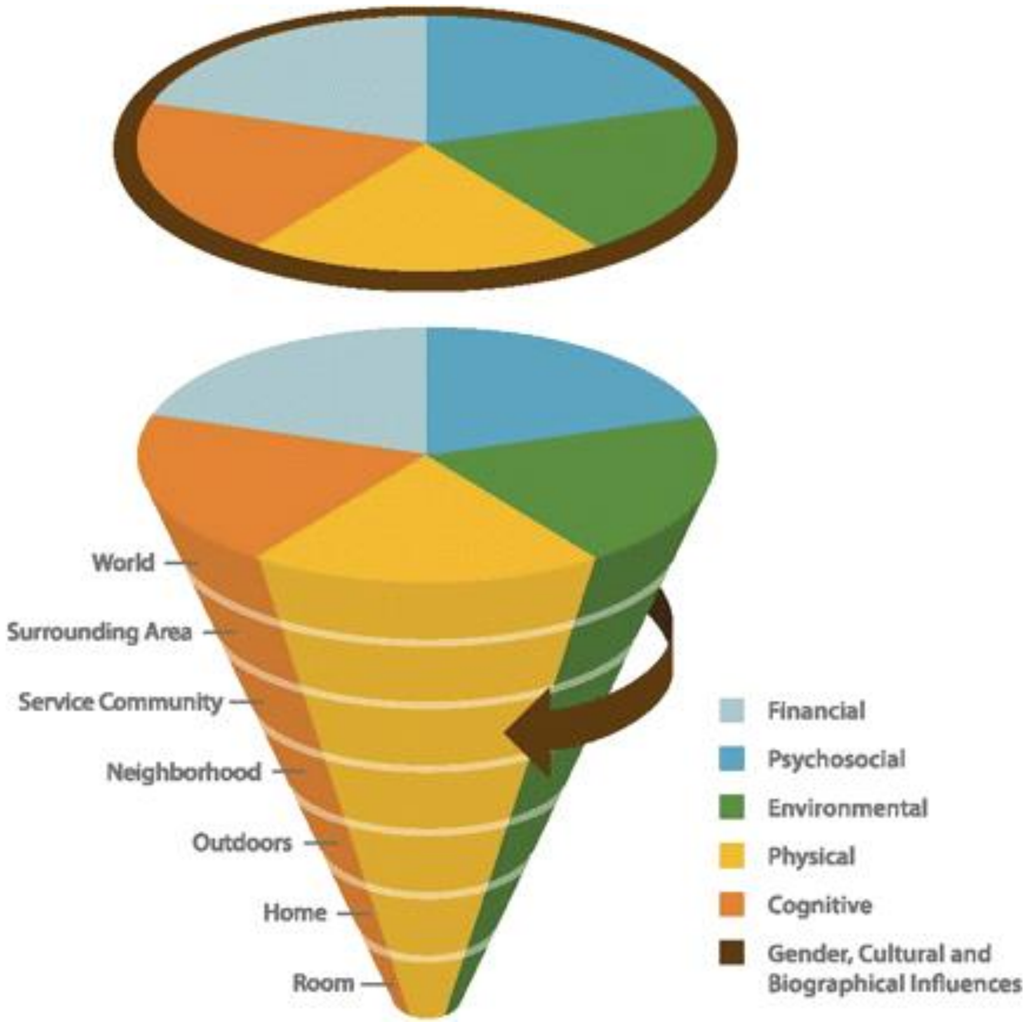
Life-Space Assessment (LSA)

In 2003, Baker and colleagues developed The University of Alabama at Birmingham (UAB) Life-Space Assessment (LSA). The LSA measures mobility in five areas: outside the bedroom, outside the house, in the neighborhood, outside of the neighborhood but in town, and outside town during the past four weeks. The LSA was validated in a random sample of 306 Medicare beneficiaries from central Alabama 65 years and older and it has emerged as the most widely used instrument in the U.S. and internationally.

The studies above fail to capture the spatial extent of mobility which goes beyond basic daily activities and encompasses an individual’s travel within the environment. Life space is the term that has been conceptualized as the spatial extent of a person's mobility involving series of concentric zones, ranging from one's bedroom to one's region of the country (May, Nayak, & Isaacs, 1985). To properly conceptualize mobility in a holistic approach, Webber, Porter & Menec, (2010) considered multiple determinants that influence mobility for older adults living independently and for those requiring care.

THEORETICAL FRAMEWORK FOR MOBILITY IN OLDER ADULTS

Figure 1



According to Webber, Porter & Menec (2010), all the various components of mobility are influenced by gender, cultural and biographical factors, as well as cognitive, physical, environmental, psychosocial, and financial factors. Cognitive determinants include factors such as memory, mental status, speed of processing and executive functioning. While psychosocial determinants include depression, fear, self-efficacy, coping behaviors and social support systems that may affect motivation to be mobile (Webber, Porter & Menec, 2010).

All the determinants of mobility in this framework are related and important for maintaining optimal mobility and well-being in older adults. For instance, full functioning in one domain will be dependent on other domains or determinants, for example, safe driving will be highly dependent on visual attention and speed of processing. Financial factors including low income may directly influence mobility and alter individual's ability to meet specific requirements in other determinant categories such as determining the location of one's home (environmental), maintaining relationships (psychosocial), access to fitness classes (physical).

For this study, evaluating the relationships between determinants and how they interact with each other to shape mobility and driving outcomes among older adults will provide useful foundation and capture specific barriers and potentially provide guidance towards policy interventions.

Socio-demographic factors and Life Space Mobility

Studies examining socio-demographics variables and Life Space Mobility have found significant associations. For example, Peel et. al (2005) measured mobility among a stratified random sample of 998 Medicare beneficiaries aged 65 years and above. Compared with the youngest age group, they found that older subjects (people aged 85 years and older) demonstrated a lower level of physical function, as indicated by higher scores for Activities of Daily Living and Instrumental Activities of Daily Living and lower SPPB scores. In another cross-sectional study in elderly Japanese people who attend orthopedic clinics, using the life-space mobility (Life-space Assessment (LSA) score), Suzuki, Kitaike & Ikezaki, (2014) found that the strongest effect predictor of LSM was gender. The Standardized partial regression coefficients (β) of gender were 0.342. Results showed that female gender had less LSA score than men. Using education and occupation as indicators of socio-economic status, Eronrn et al., (2016) found that people with low education had lower life-space mobility scores than those with intermediate or high education: marginal means 63.5, 64.8, and 70.0 ($p = .003$), respectively. In a similar study, researchers found that, compared to men participants, women participants had significantly poorer life-space mobility score (Polku et al, 2015). Further findings indicated that women participants were older, had more limited sense of autonomy in participation outdoors, were more likely to live alone, and had more chronic diseases.

Psychosocial factors and Life Space Mobility

Even though there are several independent factors associated with declines in physical functioning, there is limited research concerning association between psychosocial factors and life-space mobility. In examining the association between psychosocial factors such as depressive symptoms and life space mobility, Polku et al (2015) sampled 848 community-dwelling women and men aged 75-90 years to examine whether there is an association between different dimensions of depressive symptoms and life-space mobility. Results from the linear regression analyses showed a significant association with the CES-D total score and all the dimensions of depression, except for interpersonal problems among men. Another study by Xue and colleagues in 2008 indicated that constricted life-space mobility is associated with depressive symptoms and frailty (Xue, et. al. 2008). There is also evidence from Snih and colleagues (2012). They found that that participants with high depressive symptoms, and BMI < 18.5 or ≥ 35 Kg/m^2 were more likely to report decreased life-space. In another study, depressive symptoms were found to moderate perceived health and life-space mobility (González, Delgado, Quevedo, & Gallegos Cabriales, 2013). By adding symptoms of depression to the regression model, the β coefficients decreased suggesting partial mediation.

Among comorbidities, several studies have examined the relationship between disability, diabetes, and life space mobility. A study carried out in Brazil showed that, elders living with DM present worse functional mobility and higher risk of falls compared with elders without diabetes (Alvarenga, Pereira and Anjos, 2010). Recent studies by Kennedy and colleagues in 2019 showed that reduced life-space mobility is a strong predictor of adverse outcomes in older adults including falls, hospitalization and possibly early death (Kennedy, Williams, Sawyer, et al, 2017; 2019). In this study, researchers measured healthcare utilization (number of emergency department visits and hospitalizations) among 419 community dwelling African American and non-Hispanic White adults aged 75 years and older and found a 14% increased odds of an Emergency Department (ED) visit/hospitalization.

Predictors of Driving Outcomes

Driving is very necessary for having access to healthcare services, work and having social gathering with friends and family. Therefore, driving cessation can be one of the hardest decisions for older adults (Adler & Rottunda, 2006) as driving is very essential to older adults' sense of independence and subsequently impact their quality of life through social engagement and family involvement (Karthaus & Falkenstein 2016). Research shows that the increasing number of older drivers may consequently lead to a rise in motor vehicle crashes (Lyman, Ferguson, Braver, & Williams, 2002) and increase the risk of being killed or injured when in a motor vehicle crash (Dellinger, Kresnow, White, & Sehgal, 2004). However, it is difficult to find assessments that differentiate "at-risk" older drivers from those who are not at risk. The commonly used assessment has been on-road driving evaluations proving better face validity (Ball, Wadley, & Edwards, 2006). But other current methods of assessing driving competency such as simulator assessments and driving assessment batteries of functional abilities have been validated relative to driving safety as well as to mobility (Ball et al., 2006; Vance et al., 2006), demonstrating that, there are many alternatives for at risk older drivers to maintain or improve their driving abilities.

Decline in cognitive and physical abilities have been found to be associated with poor driving performance, or increased risk of crashes and injuries. Previous research by Marottoli and colleagues (1994; 1998) reported that physical problems such as axial and extremity flexibility, coordination, and speed of movement were predictive of driving safety. In 2007, using 178 at risk drivers aged 70 or older, they examined the impact of a physical conditioning program in increasing safe driving using on-road assessments.

Results from their study showed that the intervention group maintained driving safety across three months, while driving performance of the control group declined. Another study by Foley, Heimovitz, Guralnik & Brook, (2002) indicated that older adults outlive their driving days by 11 years for women and 6 years for men. In this situation, meeting their transportation needs become challenging even though older adults prefer driving personal vehicles as a method of transportation.

In addition, several other studies (Ball et al., 2006; Clay et al., 2005; Goode et al., 1998; Owsley et al., 1998; Rizzo, Reinach, McGehee, & Dawson, 1997), have shown that a measure of visual processing speed, the useful field of view (UFOV), is associated with crash risk in older adults. Results these studies revealed that older adults with poor UFOV scores have twice as likely to incur an at-fault crash in large population-based studies of licensed drivers (Ball et. al, 2006).

Other studies have found that after adjusting for health and socio-demographic variables, driving outcomes may be linked to negative outcomes such as reduced social interaction (Mezuk & Rebok, 2008), poorer health and greater risk of institutionalization (Freeman, Gange, Munoz, & West, 2006) and increase in depressive symptoms depression (Edwards, Lunsman, et al., 2009; Ragland, Satariano, & MacLeod, 2005). Similarly, driving outcomes are linked to health problems. For example, diabetes impacts the sensory functions of older adults making it difficult for them to drive. In diabetes, multiple eye pathologies can cause temporary or permanent visual impairment (e.g., acuity, field, color, depth, contrast, and/or binocular vision) severe enough to impede walking (Hillson, 2016). Similarly, high, or low glucose can temporarily blur vision. A study by the UK Prospective Diabetes in 1998 indicated that driving by patients diagnosed with diabetes may be impaired by three factors: hyperglycemia, hypoglycemia, and diabetes complications. For hypoglycemia, patients experience symptoms of neurologic deficit while driving and mostly attribute crash to hypoglycemia. These factors could pose a significant threat to patients with diabetes ability to drive. Koepsell et al (1994) found that there were 2.6-fold increase in injury risk for diabetic patients, which was 5.8 times higher for patients treated with insulin and 3.1 times higher for oral hypoglycemic agent, compared to older non-diabetic driver who were matched to cases on age, gender and county of residence. Hypoglycemia explains these differences in the study and implies that older adults with diabetes are more likely to quit driving and remain at home.

Several studies have shown that factors such as gender, age-related changes such as cognitive decline as well as those related to medical conditions may predict driving outcomes for older adults. Having additional information about race and psychosocial factors such as social support and depressive symptoms can help design interventions to promote safe driving in older adults.

STUDY AIMS

While disparities due to diabetes alone are widely researched, disparities related to factors from Webber framework of mobility such as demographic factors (race, gender, education, marital status), financial factor (income), psychosocial determinants (depressive symptoms, social support), physical determinants (health), environmental (health access), and cognition and life space mobility and driving outcomes in older adults are less understood.

The overall objectives of this study are to examine association between the aforementioned determinants/factors and life space mobility and driving outcomes among older Black/African Americans and Whites with diabetes. For the purpose of this study, driving outcomes are measured as driving frequency and driving exposure. Findings gathered from this study will provide preliminary evidence that can be used to make meaningful suggestions to advance the quality of care for older adults with diabetes and improve overall functioning of older adults and reduce dependency.

Hypotheses

The specific aims and hypotheses are:

Aim 1: To assess racial differences in life space mobility, driving frequency and driving exposure among older adults with diabetes:

- **Hypothesis 1:** Black/African American participants will report lower levels of life space mobility, less frequent driving and driving exposure than White participants.

Aim 2: To examine covariate-adjusted relationships among levels of cognition, depressive symptoms, and social support scores with life space mobility, driving frequency, and driving exposure:

- **Hypothesis 2A:** Older adults who report higher levels of cognition will report greater levels of life space mobility, more frequent driving, and more driving exposure, than older adults with lower levels of cognition (positive association).

- **Hypothesis 2B:** Older adults who report higher depressive symptoms will report lower levels of life space mobility, less frequent driving, less driving exposure than older adults with lower depressive symptoms (negative association).
- **Hypothesis 2C:** Older adults who report greater amount and satisfaction with social support will report lower levels of life space mobility, less frequent driving, less d riving exposure than older adults with lower depressive symptoms (negative association).

Aim 3: To determine if the associations of cognition with life space mobility, driving frequency and driving exposure are moderated by depressive symptoms and social support:

- **Hypothesis 3A**: Depressive symptoms will moderate the associations of cognition with life space mobility, driving frequency and driving exposure.
- **Hypothesis 3B**: Amount of support received will moderate the associations of cognition with life space mobility, driving frequency and driving exposure.
- **Hypothesis 3C**: Satisfaction of support will moderate the associations of cognition with life space mobility, driving frequency and driving exposure.

MEHTODS

Procedure

This study used baseline data from the University of Alabama at Birmingham (UAB) Diabetes and Aging Study of Health (DASH). At baseline, 247 individuals were enrolled. 10 individuals were removed from analyses because they identified as races other than Black/African American and White. The primary aim of DASH was to examine potential disparities between older African Americans and Whites with diabetes, therefore there was no reason to include other races. Participants included individuals in the Center for Translational Research on Aging and Mobility with type 2 diabetes and community-dwelling older adults aged 65 and older living in central Alabama. Blacks/African Americans and males were oversampled to achieve approximately equal sample in terms of race and gender. The study protocol was approved by the UAB Institutional Review Board. Potential participants were contacted via mail to explain the purpose of the study. If they consented to participate, they received a follow-up telephone call. Telephone follow-up interviews were used to assess all predictors and outcome variables of the study at yearly intervals over 2 years.

Measures

Predictors

Demographic variables: Age, gender, race, marital status, education, and household income were self-reported in the baseline. Age was a continuous variable ranging from 65 to 90 years. Gender was recoded as 0 for male and 1 for female. Race was recoded as 1 for White and 2 as Black. Marital status was recoded into 0 as not married and 1 as married. Household income was recoded into 1 as less than $35,000 and 2 as more than $35,000 and these were reported as percentages. In addition, participants reported their general health status. They were asked to rate their general health and scores ranged from 1 – 5 with 1 as poor health and 5 as excellent health. Access to health was a single item question which asked participants to report how close they are to their primary healthcare facility. This was calculated in minutes and ranged from 2 minutes to 90 minutes. In this study age, gender, education, income, health status, access to healthcare and marital status were analyzed as covariates while race was analyzed as the predictor variable. Depressive symptoms, amount of support received and satisfaction with support will be analyzed as moderating variables.

TICS-M: Cognitive function was measured using the Modified Telephone Interview for Cognitive Status (TICS-M)**.** This is a brief test of global cognitive performance, and scores can potentially range from 0 to 39. Questions of orientation, attention/calculation, registration, repetition, recent memory and delayed recall, semantic memory and comprehension are some items covered. The TICS-M is a reliable and valid measure with a sensitivity of 94% and specificity of 100% for distinguishing normal controls from people living with dementia (Brandt et al., 1993). A higher score indicates greater cognitive function, and a score of 20 or lower suggests cognitive impairment.

The Geriatric Depression Scale: Symptoms of depression were assessed using the GDS 15-item short form (Sheikh & Yesavage (1986). The GDS has been tested and used extensively with the older population. It is a brief 30-item questionnaire in which participants are asked to respond by answering yes or no in reference to how they felt over the past week. It has been successful in differentiating depressed from non-depressed adults with a high correlation ($r = .84$, $p < .001$) (Sheikh & Yesavage, 1986). Of the 15 items, 10 indicated the presence of depression when answered positively, while the rest (question numbers 1, 5, 7, 11, 13) indicated depression when answered negatively. Scores of 0-4 are considered normal, depending on age, education, and complaints; 5-8 indicate mild depression; 9-11 indicate moderate depression; and 12-15 indicate severe depression.

Social support: Social support was measured using a modified version of the Medical Outcomes Survey (MOS-SS) (Sherbourne & Stewart, 1991). The modified version asks questions about the amount of support received and satisfaction with the support they receive. For amount of support received from other in relation to their diabetes, participants are asked "How much support do you get dealing with your diabetes?" The response options range from 1 (no support) to 5 (a great deal of support). For satisfaction with social support participants are asked "How satisfied are you with the support you get for dealing with your diabetes?" and the response options range from 1 (not at all satisfied) to 5 (extremely satisfied). Higher scores on each question indicate greater social support.

Outcome Measures

Life-Space Mobility: The UAB Study of Aging Life-Space Assessment (LSA) was used to measure mobility based on the distance through which an individual reports moving during the 4 weeks preceding the baseline assessment (Baker, Bodner & Allman, 2003). The Life Space Assessment assessed five different types of questions on life-space: within-home, around home, neighborhood, town and outside of town. For each level of life-space, participants were asked the frequency of movement during the previous 4 weeks, and whether they needed help assistance from another person or a device to move from one level to another. LSA scores ranged from 0 to 120, with higher scores reflecting greater life-space mobility.

Driving Habit Questionnaire (DHQ):

Participants in the DASH reported their driving behaviors in terms of frequency and exposure for each driving situation (Owsley, Stalvey, Wells, Sloane, 1999). The DHQ contains items that assessed driving habits in eight situations including making lane changes, merging into traffic, driving alone, driving in the rain, rush-hour driving, driving at night, driving on high-traffic roads, and making left-hand turns across oncoming traffic.

For each driving situation, participants also had the option to report that they did not engage in that situation. If they did not engage, they were then asked to report whether their lack of engagement was due to purposeful avoidance of that situation.

Driving frequency: Driving frequency was measured with a single item question asking participants "In an average week, how many days out of seven do you normally drive?". Response range from 0-7 with higher scored indicating greater frequency.

Driving exposure: exposure was measured by asking participants if they had driven alone, made lane changes, driven in high traffic, turned left unto oncoming traffic, driven at night or in the rain, merged with traffic or driven during rush hour in the last 2 months. Items were coded and summed to form driving exposure. Scores range from 0-8 with higher scores indicating more exposure to the eight driving situations.

Data analysis

All analyses were conducted with SPSS version 27 (IBM Corp, 2020) and significance was evaluated at $p < .05$ for two-tailed tests.

Initial analyses were conducted to describe the sample. Unadjusted racial differences in demographics (age, gender, income, marital status, and education), health status, healthcare access, cognitive function, depressive symptoms, amount of social support, and satisfaction with support and outcome variables (life space mobility, driving frequency and driving exposure) were examined through Chi-Square test of independence (categorical) and independent samples t-test for continuous measures.

A series of covariate-adjusted, hierarchical linear regression models were conducted to examine the study hypotheses. These models were adjusted for age, gender, income, marital status, education, health status and healthcare access. For each outcome, 4 models were conducted. Race entered in step 1 for all outcomes. Age, gender, marital status, education, income, access to healthcare and health status were entered as covariates in step 2 for all three outcomes. Cognitive function, depressive symptoms, amount of support received and satisfaction with support were entered in step 3 for all three outcomes. Finally, to test that depressive symptoms, amount of support received and satisfaction with support moderate the associations of cognition with life space mobility, driving frequency and driving exposure, interaction terms were created and entered in step 4 for all three outcomes.

RESULTS

Sample descriptive statistics

Table 1 represents descriptive statistics of the study sample and racial differences of all variables used in this current study. There were significant racial differences in age, gender, marital status, education, and income. On average, Blacks/African Americans were younger (t = 2.34, p = .018), more likely to be female (χ^2 = 8.76, p < .01), less likely to be married, (χ^2 = 13.08, p < .001), less educated (t = 2.93, p < .01), and reported low household income (t = 5.73, p < .01) than Whites. To assess racial differences in life space mobility, driving frequency, driving exposure, cognition, depressive symptoms, and social support among older adults with diabetes, independent samples t-tests were used. There were no racial differences in amount of support received and satisfaction with support, however, Blacks/ African Americans reported lower cognitive functioning (t = 5.26, p < .001), more depressive symptoms (t = -2.74, p < .01), less life space mobility (t = 4.42, p < .001), less driving (t = 3.06, p < .01), and less driving exposure (t = 4.07, p < .01) than Whites. In addition, Blacks/ African Americans reported less access to healthcare (t = 2.80, p < .01) than Whites and there were no differences among Blacks/ African Americans and Whites on self-reported health. Hypotheses 1 was supported.

Table 1: Sample Descriptive Statistics/Bivariate Racial Differences on Variables of Interest

Variable	White (n=137) Mean (std)/ N (%)	Blacks/African Americans (n=110) Mean (std)/ N (%)	*t or* (χ^2)	*p*
Age	74.13 (6.31)	72.39 (5.66)	2.34	.018
Female Gender	60 (46.51%)	69 (53.48%)	(8.76)	.003
Married	79 (67.79%)	38 (32.20%)	(13.08)	<.001
Years of Education	13.93 (2.55)	12.95 (2.67)	2.93	<.01
Income	1.50 (0.50)	1.17 (0.37)	5.73	<.001
Cognitive Function	24.92 (5.41)	21.35 (5.14)	5.26	<.001
Amount of Support	3.73 (1.49)	3.73 (1.56)	.061	.951
Satisfaction w/ Support	4.45 (0.84)	4.49 (0.83)	-.388	.699
Depressive Symptoms	2.26 (2.49)	3.28 (3.36)	-2.74	<.01
Life Space	73.92 (22.13)	61.84 (20.39)	4.42	<.001
Driving Frequency	4.69 (2.25)	3.72 (2.70)	3.06	.002
Driving Exposure	6.75 (2.45)	5.29 (3.17)	4.07	.003
Access to Healthcare	25.10 (17.77)	19.68 (10.84)	2.80	.003
General Health	3.12 (0.98)	2.99 (1.00)	1.04	0.14

Bivariate Correlations

Bivariate correlations were used to examine unadjusted relationships between levels of cognition, depressive symptoms, scores on driving frequency, exposure, and life space mobility. Results show significant positive correlation between cognitive function and life space mobility ($r = .305$, $p < .01$), cognitive function and driving exposure ($r = .324$, $p < .01$) and cognitive function and driving frequency ($r = .272$, $p < .01$). On the other hand, there was significant negative correlation between depressive symptoms and life space mobility (*r* = -.387, *p* < .01), depressive symptoms and driving exposure (*r* = -.320, *p* < .01) and depressive symptoms and driving frequency (*r* = -.338, *p* < .01).

Table 2: Bivariate Correlations on Variables of Interest

Variables	1	2	3	4	5	6	7
1 Cognitive Function	1						
2 Life Space	.305**	1					
3 Driving Exposure	.324**	.481**	1				
4 Driving Frequency	.272**	.634**	.785**	1			
5 Depressive Symp	-.264**	-.387**	-.320**	-.338**	1		
6 Amount of support	.023	.156*	.041	.010	.033	1	
7 Sat. with support	.082	.192**	.095	.105	.010	.572**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Note: sat. = satisfaction; Symp = Symptoms

Covariate-Adjusted Associations of Race, Cognition, Depressive Symptoms and Social Support with Life Space Mobility

To assess the association of variables of interest with each outcome (life space mobility, driving frequency and driving exposure), multiple covariate-adjusted regression models were tested. Table 3 represents the covariate-adjusted associations of cognition, depressive symptoms, amount of support received and satisfaction with support with life space mobility.

From table 3, in model 1, being Black/African American was associated with lower life space mobility (*B* = -.271, *p* < .001). In model 2, being Black/African American was also associated with life space mobility after covariates were added to the model (*B* = -.185, *p* < .05). Being female also (*B* = -.128, *p* < .05) was associated lower life space mobility. Being married (*B* = .147, *p* < .05), educated (*B* = .146, *p* < .05), and reporting better health (*B* = .306, *p* < .001), were also significantly associated with greater life space mobility. In model 3, being older (*B* = -.114, *p* < .05), and female (*B* = -

.150, $p < .05$) were associated with lower life space mobility, while being married (B = .137, $p < .05$), and reporting better health (B = .202, $p < .05$), were associated with greater life space mobility. Similarly, higher cognitive function was associated with greater life space mobility (B = .140, $p < .05$) while higher depressive symptoms were associated with lower life space mobility (B = -.225, $p < .05$).

Amount of support received and satisfaction with support were not associated with life space mobility (all *p*'s > .05). All the interaction terms were also not significant. However, being Black/African American (B = -.126, $p < .05$) and female (B = -.138, $p < .05$), were associated with lower life space mobility in model 3, and being married (B = .145, $p < .05$) and having good health (B = .205, $p < .05$) were associated with greater life space mobility.

Table 3: Covariate-Adjusted Associations of Race, Cognition, Depressive Symptoms and Social Support with Life Space Mobility

Measures	Model 1 *B*	p	Model 2 *B*	p	Model 3 *B*	p	Model 4 *B*	p
Black/African American race	-.271	.001	-.185	.003	-.120	.056	-.126	.046
Age			-.114	.052	-.114	.049	-.114	.050
Female gender			-.128	.041	-.150	.014	-.138	.024
Married			.147	.023	.137	.029	.145	.022
Education			.146	.020	.086	.171	.092	.150
Income			-.018	.798	-.030	.663	-.033	.641
Access to Healthc			.019	.736	.023	.674	.020	.718
Health			.306	<.001	.202	.002	.201	.002
Cognitive Function					.140	.023	-.394	.232
Amount of support					.065	.271	-.004	.989
Sat. w/ support					-.064	.281	-.406	.098
Depressive Symptoms					-.225	<.001	-.328	.123
Depression_Cognition							.101	.618
Amt of SR_Cognition							.080	.798
Sat. w/ sup_Cognition							.596	.149
Adjusted R^2	0.07		.248		.300		.300	
R^2 change	0.07***		.198***		.062***		.008	

Note: ***B*** *= Standardized Beta; p = p-value; Amt of SR. = Amount of Support Received; Sat w/ sup= Satisfaction with support; Healthc = Healthcare. Depression_cognition = interaction between depression and cognition; Amt of SR_Cognition = interaction* *between amount of support received and cognition; Sat. w/ sup_Cognition = interaction between satisfaction with support and cognition.*

*Model R2 change= *p < .05, **p < .01, ***p < .0001 for r-square change.*

Covariate-Adjusted Associations of Cognition, Depressive Symptoms and Social Support with Driving Frequency

After controlling for age, gender, marital status, education, income, access to healthcare and health status, race, cognitive function, and depressive symptoms were associated with driving frequency. Being Black/African American was associated with less driving frequency (B = -.192, $p < .05$), high cognitive function was associated with more driving frequency (B = .137, $p < .05$) and higher depressive symptoms was associated with less driving frequency (B = -.176, $p < .05$). Race was no more associated after covariates were added to the model. After interaction terms were added to the model, greater amount of support received was associated with less driving frequency (B = -.565, $p < .05$).

Table 4: Covariate-Adjusted Associations of Cognition, Depressive Symptoms and Social Support with Driving Frequency

Measures	Model 1 *B*	p	Model 2 *B*	p	Model 3 *B*	p	Model 4 *B*	p
Black/African American Race	-.192	.002	-.068	.257	-.007	.910	-.007	.906
Age			-.062	.281	-.058	.308	-.060	.295
Female gender			-.273	<.001	-.293	<.001	-.291	<.001
Married			.096	.131	.095	.125	.090	.148
Education			.191	.002	.143	.022	.158	.012
Income			.007	.923	-.003	.965	-.006	.931
Access to Healthc			.014	.799	.021	.706	.020	.722
Health			.284	<.001	.188	.003	.185	.003
Cognitive Function					.137	.024	-.047	.886
Amt of SR					-.066	.259	-.565	.034
SS w/ support					-.028	.641	.101	.676
Depressive Symptoms					-.176	.008	-.297	.157
Depression_Cognition							.129	.519
Amt of SR_Cognition							.605	.052
Sat. w/ sup_Cognition							-.216	.596
Adjusted R^2 R^2 Change	.033 .037**		.277 .264***		.312 .045**		.317 .1.57	

Note: ***B*** *= Standardized Beta; p = p-value; Amt of SR/Amt of SR = Amount of Support Received; Sat w/ Sup= Satisfaction with support; Healthc = Healthcare. Depression_cognition = interaction between depression and cognition; Amt of*

SR_Cognition = interaction between amount of support received and cognition; Sat. w/ sup_Cognition = interaction between satisfaction with support and cognition.

*Model R2 change= *p < .05, **p < .01, ***p < .0001 for r-square change.*

Covariate-Adjusted Associations of Cognition, Depressive Symptoms and Social Support with Driving Exposure

Covariate-adjusted regression model with driving exposure as the dependent variable with cognitive function, depressive symptoms, amount of support received and satisfaction with support as independent variables was examined. Again being Black/African American was associated with less driving exposure ($B = -.252$, $p < .05$). This effect was reduced after covariates were added to the model. In addition, higher cognitive function was associated with more driving exposure ($B = .187$, $p < .05$) while higher depressive symptoms was associated with less driving exposure ($B = -.140$, $p < .05$). Amount of support received and satisfaction with support were not associated with driving exposure (all p >.05).

Table 5: Covariate-Adjusted Associations of Cognition, Depressive Symptoms and Social Support with Driving Exposure

Measures	Model 1 *B*	p	Model 2 *B*	p	Model 3 *B*	p	Model 4 *B*	p
Black/African American Race	-.252	.001	-.164	.009	-.087	.172	-.080	.203
Age			-.065	.270	-.047	.430	-.054	.354
Female gender			-.174	.006	-.199	.001	-.200	.001
Married			.108	.097	.109	.089	.095	.132
Education			.192	.003	.132	.041	.144	.024
Income			-.033	.653	-.036	.609	-.032	.650
Access to Healthc			-.012	.829	-.009	.873	-.004	.937
Health			.278	<.001	.202	.002	.206	.001
Cognitive Function					.187	.003	-.090	.785
Amt of SR					-.016	.795	-.515	.057
SS w/ support					-.074	.224	.057	.817
Depressive Symptoms					-.140	.041	-.626	.004
Depression_Cognition							.498	.015
Amt of SR_Cognition							.621	.049
Sat. w/ sup_Cognition							-.224	.588
Adjusted R^2	.060		.232		.271		.297	
R^2 Change	.064***		.193***		.050**		.034**	

Note: ***B*** *= Standardized Beta; p = p-value; Amt of SR = Amount of Support Received; Sat w/ sup = Satisfaction with support; Healthc = Healthcare. Depression_cognition = interaction between depression and cognition; Amt of SR_Cognition = interaction* *between amount of support received and cognition; Sat. w/ sup_Cognition = interaction between satisfaction with support and cognition.*

R^2 *change was significant for all models.* *$p < .05$, **$p < .01$, ***$p < .0001$ *for r-square change.*

Visual Display of hypotheses

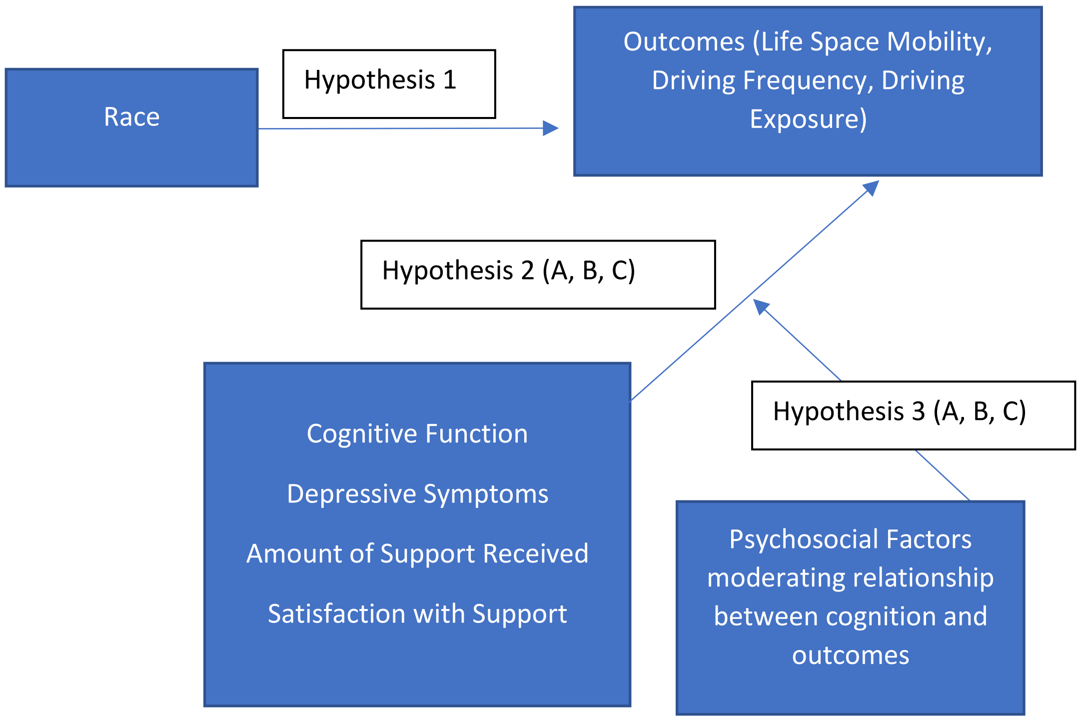


Figure 2: ***Combined moderation analyses of variables of interests.***

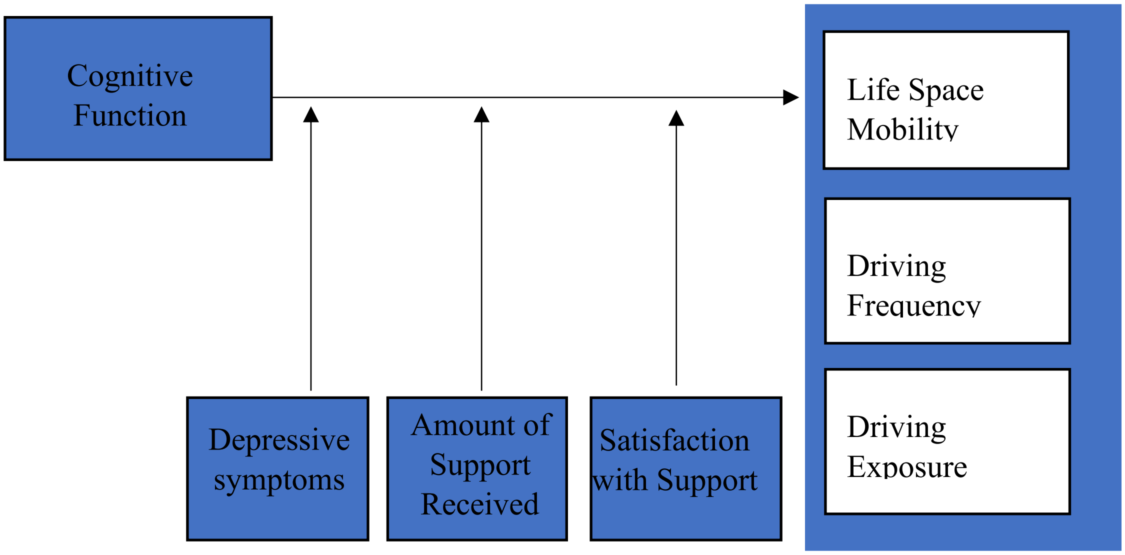


Figure 3: ***Moderation Analysis with depressive symptoms, amount of support received and satisfaction with support as moderators of the relationship between cognitive function and life space, driving frequency and driving exposure.***

Interacting depressive symptoms, amount of support received and satisfaction with support with cognitive function in the models did not affect the relationship between cognitive function and life space mobility. When the same moderators were examined between cognitive function and driving frequency, results from the covariate-adjusted model showed no significant explanation. However the examination of the same moderators of the relationship between cognitive function and driving exposure was significant. Depressive symptoms has a significant moderating effect on the relationship between cognitive function and driving exposure. For individuals with lower cognitive function, those with high depressions symptoms showed lower levels of driving exposure compared to those with low depressive symptoms. This difference was not present for individuals with high levels of cognitive function (Figure 4; *B* = .498, $p < .05$). The amount of support received and satisfaction with support did not moderate the relationship between cognitive function and driving exposure.

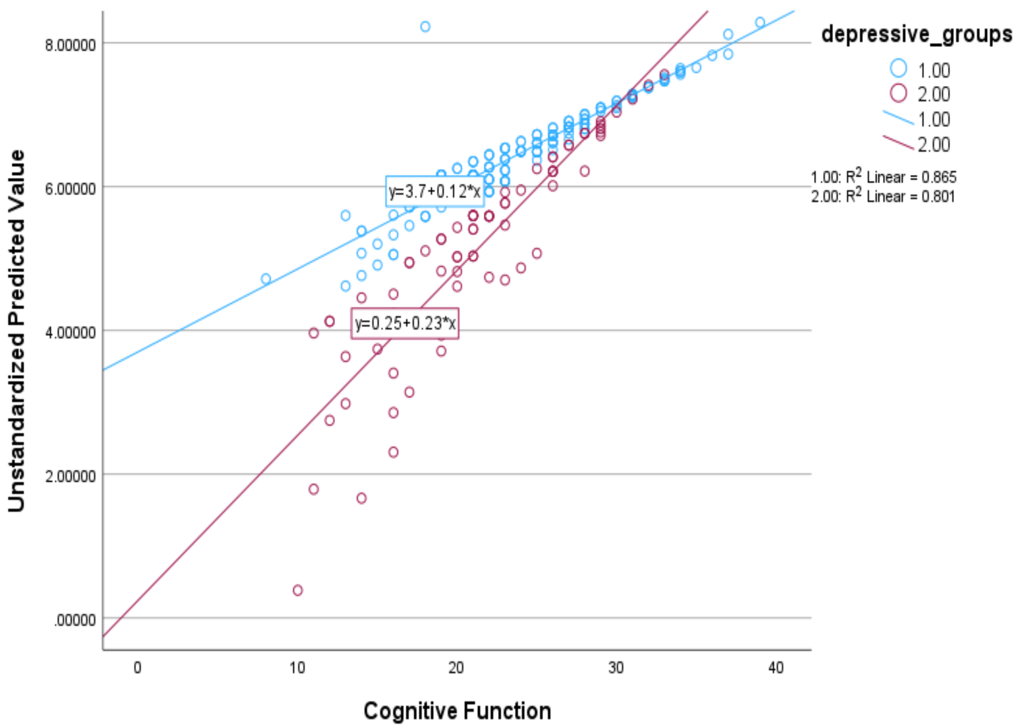


Figure 4: ***Interaction between cognitive function and depressive symptoms and driving exposure as DV. Depressive symptoms were categorized into 2 groups – lower levels of depressive symptoms (group 1) and higher levels of depressive symptoms (group 2). This was calculated using the SD cut off of 3.01.***

DISCUSSION

This study aimed to examine the associations of race, cognitive function, depressive symptoms and social support with life space mobility, driving frequency and driving exposure among older Black/African Americans and Whites with diabetes. It also aimed to investigate the effect of depressive symptoms and social support as moderators of the associations of cognitive function and the 3 outcomes (life space mobility, driving frequency and driving exposure). Results from bivariate association using independent samples t-test and Chi-square test of independence revealed significant racial differences in age, gender, income, education, marital status, cognitive function, depressive symptoms, life space mobility, driving frequency and driving exposure. Specifically, Black/African American participants were younger, more likely to be female, less likely to be married, less educated, and reported low income than White participants. In addition, Black/African American participants reported lower cognitive functioning, more depressive symptoms, less life space mobility, less driving frequency, and less driving exposure than White participants.

After controlling for age, gender, marital status, income and education, race remained a significant direct predictor of life space mobility, driving frequency and exposure. For life space mobility as an outcome, the findings on racial differences are consistent with other studies that examined racial differences on life space mobility, although these previous studies defined life space mobility differently (Boyle et al., 2010; Rosso et al., 2013; Sartori et al., 2012, Choi et al., 2016). Establishing these racial differences in mobility within a health disparities framework would be important as it would draw attention to functioning in later life for socially disadvantaged groups.

The study also examined associations between cognition and depressive symptoms and life space mobility, driving frequency and driving exposure. Results show significant positive correlation between cognitive function and life space mobility, cognitive function and driving exposure, and cognitive function and driving frequency. Individuals who reported higher cognitive functioning reported greater life space mobility, more frequent driving and more driving exposure. These findings support previous findings that examined the direct baseline association between cognitive function and life space mobility in community-dwelling older adults (Béland, et al., 2018). Other studies that examined speed of processing and executive functioning demonstrated that poor performance on the Trial Making Tests was associated with lower life space mobility scores while good performance was found to be associated with higher life space scores (Poranen-Clark, et al., 2018). This result was also consistent with a cross-sectional study that found that higher cognitive functioning reduced the odds of being restricted to the home and neighborhood (Curcio, et al., 2013; Barnes, et al., 2007). On the other hand, there was significant negative correlation between depressive symptoms and life space mobility, depressive symptoms and driving exposure and depressive symptoms and driving frequency.

The final aim sought to assess whether the associations between cognition and life space mobility, driving frequency and driving exposure are moderated by depressive symptoms and social support. Depressive symptoms was found to be a significant moderator on the relationship between cognitive function and driving exposure. For individuals with lower cognitive function, those with high depressions symptoms showed lower levels of driving exposure compared to those with low depressive symptoms. This difference was not present for individuals with high levels of cognitive function. This synergistic interaction effect between cognitive function and depressive symptoms with driving exposure is important for researchers and clinicians when screening or treating older patients with diabetes. Other studies have shown similar findings (Polku et al., 2015). The amount of support received and satisfaction with support did not moderate the relationship between cognitive function and driving exposure.

Limitations

Although the present study provide informative results for future research, there are some limitations. The use of self-reported measures on life-space mobility, driving exposure and driving frequency can be subject to recall bias. Although the questionnaires used to quantify mobility in the study are well established and validated to be used for community dwelling older adults (Owsley, et al., 1999; Stalvey, et al., 1999), objective assessments of mobility such as on-road tests would have been helpful. In addition, mobility can be impacted by several environmental factors including sidewalks, parks and safety. These constructs were not measured in the study; hence potential confounds may have influenced participants responses on mobility. Lastly, this study used cross-sectional data making it difficult to determine cause and effect. As a result, the associations between some of the variables examined may be directional.

Implications

Findings from this study have significant implications for researchers, healthcare practitioners as well as friends and families of older adults with diabetes.

For researchers, the findings provide new insights to address issues relating to regular assessment of older adults' life space mobility outside of the home, use of appropriate driving assessments tools and applying different methodological approaches to reach large sample of older adults in future studies. In addition, the present study only analyzed baseline data and did not examine the effects of time-varying covariates. Changes in cognition, depressive symptoms and social support over time may be associated with changes in life space mobility and driving. Hence, more longitudinal and interventional studies are needed to better understand changes in life space mobility and driving outcomes. Also, researchers planning interventional studies should consider driver education programs involving on-road training and testing to improve the overall performance of older drivers during challenging driving situations such as making lane changes, driving at night and making left turns.

Findings from the study also provide new perspectives for healthcare practitioners for racially targeted educational interventions for individuals who are at risk for reduced life space mobility and driving outcomes. Cognitive dysfunction and depressive symptoms should be considered as barriers to life space mobility and driving frequency and exposure when discussing and planning tailored patient interventions for older adults with diabetes.

Finally, the importance of social support for older adults in this study is critical for promoting overall quality of care and functioning and reducing dependency. Psychosocial intervention regimens and education should consider increasing the support systems and social networks of older adults with diabetes.

Conclusion

The present study has highlighted the importance of driving and life space mobility beyond the immediate home of older adults. The study has determined the association between cognitive function, depressive symptoms and social support and life space mobility, driving frequency and driving exposure among older adults with diabetes. The key results suggest that a relationship exist between these factors after adjusting for demographics, general health and access to healthcare. Thus, this study makes a unique contribution to literature by expanding on the theoretical connections between cognition and psychosocial factors and mobility as postulated by the Webber Framework of mobility. Although it is unclear in other studies whether cognitive impairment precede life space mobility restrictions or vice versa, this present study highlights the importance to recognize life space mobility as an outcome due to the observable contributing factors to life space such as driving frequency and driving exposure, as well as depressive symptoms and social support networks. Given the importance of mobility, particularly driving and building relationships outside of the home through community engagement, results from this study will be helpful in enhancing life space which may be an initial practical aging intervention to identify people who are at risk for lower mobility as assessed in the present study. It is hoped that findings from this study will influence future research and promote interventions targeted at improving mobility for older adults.

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APPENDICES

A. IRB APPROVAL LETTER

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Office of the Institutional Review Board for Human Use

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APPROVAL LETTER

TO: Armah, Henrietta

FROM: University of Alabama at Birmingham Institutional Review Board
Federalwide Assurance # FWA00005960
IORG Registration # IRB00000196 (IRB 01) IORG Registration # IRB00000726 (IRB 02) IORG Registration # IRB00012550 (IRB 03)

DATE: 22-Feb-2022

RE: IRB-300008725
IRB-300008725-005
Correlates of Life Space Mobility and Driving Avoidance among Older African

Americans and Whites with Diabetes

The IRB reviewed and approved the Initial Application submited on 18-Feb-2022 for the above referenced project. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services.

Type of Review:

Exem

pt **Exempt Categories:** 4

Determination:

Exem

pt **Approval Date:** 22-

Feb-2022

Approval Period: No Continuing Review