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Research Article

# Type 2 Diabetes Management Among Homebound Older Adults

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## Abstract

**Objective:** The objectives of this study was to examine the methods homebound older adults used to control their blood glucose, the extent to which they were able to perform Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs), as well as to determine if they were subject to depression.

**Research Design and Methods:** A self-designed questionnaire was used on 21 homebound older adults, aged 60 years or older, diagnosed with Type 2 diabetes, a participant of Meals-on-Wheels or Salvation Army Golden Nutrition Dinner program and residing in DeKalb and Kane Counties of Illinois. Data collection began as soon as the informed consents were signed over a six-month rolling period.

**Results:** Self-blood glucose monitoring was the most reported primary method of blood glucose control (n = 9, 42.9%); average blood glucose of 50 mmol/mol (HbA1c 6.7%). Participants were highly independent in ADLs and moderately independent in IADLs. When diet therapy was reported as the primary method of control; mean blood glucose level was 33 mmol/mol (101.00±73.91 mg/dL). No significant relationship found between ADL score and blood glucose levels (p=0.686) nor between depression and ability to perform ADLs (p=0.524) and/or IADLs (p=0.944).

**Conclusion:** Self-blood glucose monitoring was the reported primary method of blood glucose control yet, diet therapy as the primary method provided the most well controlled blood glucose levels.

## Introduction

Type 2 diabetes is a metabolic disorder characterized by hyperglycemia (elevated blood glucose levels >42 mmol/mol; >126 mg/dL) and altered carbohydrate and lipid metabolism [1]. A deficiency of insulin production from pancreatic beta cells can result in hyperglycemia during an Oral Glucose Tolerance Test (OGTT) [1]. Individuals with Type 2 diabetes are at an increased risk for cardiovascular disease due to dyslipidemia (abnormal blood lipid levels), hypertension, and obesity (BMI >30 kg/m$^2$) [1,2]. The recommended medical nutrition therapy for individuals with Type 2 diabetes is weight loss and carbohydrate counting. For weight loss, reducing total energy intake by 500 - 1,000 kcals/day, typically results in an average 26-to 52-pound weight loss after six months. Weight loss can reduce cardiovascular strain and organ inflammation to better control blood lipid circulation and increase insulin sensitivity [1].

There has been little research conducted to assess the most utilized practices of Type 2 diabetes management for homebound older adults who participate in supplemental meal programs such as Meals-on-Wheels (MOW) or Salvation Army Golden Dinner Nutrition (SAGDN). Of the 29.1 million individuals reported to have diabetes in the United States, 11.2 million of those individuals are aged 65 and older [3]. Over $245 billion was spent on diabetes-related healthcare costs in 2012, with the average individual diagnosed with diabetes costing 2.3 times more than an individual without diabetes [3,4]. By 2030, approximately 72.1 million people, almost 20% of the US population, will be aged 65 and older, with more than a 50% increase in those aged 85 and older due to the aging "Baby boomer" generation and longer life expectancy [5,6]. In 2012, individuals aged 65 and over accounted for about 70% of Long-term Services and Support (LTSS) and those aged 85 and over are four times more likely to need LTSS. The Centers for Medicare and Medicaid Services (CMS) National Health Expenditures totals the national spending on LTSS at about $310 billion; with Medicare accounting for about 51% of the total

expenditures [7]. About 60% of adults older than 60 years of age present with abnormal glucose control which may be due to current lifestyle modification recommendations focusing on young and middle-aged individuals and my not be suitable for older adults [8].

Management of Type 2 diabetes includes use of medication, physical activity, and nutrition therapy. The typical diet for an individual with diagnosed Type 2 diabetes consists of about 20% of total calories from protein and 25-30% of total calories from fat [1]. Commonly, individuals diagnosed with Type 2 diabetes are prescribed medications such as sulfonylureas, insulin sensitizers, biguanides, insulin or a combination of oral medications, dietary interventions; carbohydrate counting, physical activity, and/or self-blood glucose monitoring such as finger pricks. Many people with diagnosed diabetes only receive about two hours of formal diabetes education during their hospital visit, which leaves them feeling overwhelmed with their diabetes-related care [9].

Typically, older adults with Type 2 diabetes display high levels of cognitive impairment, specifically in learning and memory. Qui et al. studied the patterns of cognitive deficits and Activities of Daily Living (ADLs) among 301 homebound participants with diabetes aged 60 years and older. Those with diagnosed diabetes showed poorer performance on ADLs due to the association with deficits in cognition and executive functioning; however, up to 17% of homebound individuals have undiagnosed cognitive impairments [7,10]. Wajnberg et al. found similar results, as 91% of their 318 participants required assistance with one or more ADLs. The study showed that symptom burden in the chronically ill homebound individuals was similar in severity to that of individuals in hospice or hospitalization [5]. Although their study population was not specifically targeting homebound older adults with diabetes, the results are significant in that even younger homebound individuals have decreased ADL function.

In the Nutrition, Aging, and Memory in the Elderly (NAME) study of 976 subjects with an average age of 75.3 years old, researchers found that the depressed older adults who were homebound had significantly higher consumption of high-glycemic foods and higher levels of fasting insulin than those without depression [11]. Poor social support is also a predictor of fewer adherences to prescribed therapies of medication, nutrition, and physical activity [12]. The homebound population has high disease and symptom burden, substantial functional limitations, and higher mortality than the non-homebound population. Also, the homebound population uses healthcare services at higher rates than the non-homebound population. Homebound individuals are associated with markers of greater socioeconomic vulnerability: elderly, low income, and higher prevalence of hospitalization due to social, psychological, and/or environmental phenomena [13].

In 1972, Congress implemented a supplemental feeding program, Meals-on-Wheels and Salvation Army Golden Dinner Nutrition, to nutritionally aid homebound and non-homebound individuals who are 60 years and older. An estimated 7% of US adults over the age of 65 receive these home-delivered meals to compensate for the inability to prepare their own meals. Although Meals-on-Wheels was developed as a supplemental-nutrition feeding program, 74% of the applicants are considered at nutritional risk [14]. Not all applicants can be considered homebound, yet there is a high rate of nutritional deficiencies among this group.

The purpose of the current study was to examine what methods homebound older adults were using to control their blood glucose, the extent to which they were able to perform Activities of Daily Living (ADLs) and instrumental Activities of Daily Living (IADLs), as well as to determine if they were subject to depression. The objectives of this study were to; 1. Determine the most common practices among older adult homebound diabetics in managing T2D, 2. Identify the level of care needed among older adult homebound diabetics to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs), and 3. Assess the level of depression among the older adult homebound diabetic population. The study also asked the following research questions:

1. What is the most common primary practice of blood glucose control among homebound older adults living with T2D?,
2. What is the relationship between primary blood glucose method and blood glucose level among homebound older adults with T2D?,
3. To what extent are homebound older adult diabetics able to perform ADLs and IADLs?,
4. What is the relationship between ADL score and blood glucose level among homebound older adults with T2D?,
5. What is the relationship between the level of depression and blood glucose level of older adult homebound diabetics?, 6. To what extent does depression relate to the ability of older adult homebound diabetics to perform ADLs and IADLs?

## Research Design and Methods

Permission was obtained from the Institutional Review Board of Northern Illinois University. This was a cross-sectional epidemiological study consisting of a convenience sampling of homebound individuals, aged 60 years or older with diagnosed Type 2 diabetes. Participants were current residents of DeKalb or Kane Counties of Illinois and who participated in Meals-on-Wheels (MOW) and Salvation Army Golden Dinner Nutrition (SAGDN) programs. Subjects with severe cognition problems such as dementia and Alzheimer's disease were excluded.

Data collection spanned over a six-month period using a rolling submission for voluntary questionnaire data collection. Each participant was assigned a personal identification number and questionnaires were verbally given to consenting participants by the researcher in their home or in a designated private room at

congregate meal sites. The questionnaire consisted of a modified-version of the Standard Chronic Disease Self-Management, Katz Questionnaire of ADLs, Lawton IADL Scale, Diabetes Self-Management Questionnaire, and the Geriatric Depression Scale.

### Outcome Assessment

Controlled blood glucose was defined as <48 mmol/mol ($HbA_{1c}$ 6.6%, <140 mg/dL), whereas uncontrolled was ≥48 mmol/mol ($HbA_{1c}$ 6.6%, ≥140 mg/dL) as recommended by the American Diabetes Association [15]. High independence on the Katz ADL questionnaire was a score of 6 [16]. High independence on the Lawton IADL questionnaire was 8 [17]. The Geriatric Depression Scale is categorized into three categories: a score of 0-5 suggests no depression, >5 suggest depression is present, and a score ≥10 almost always is indicative of present depression [18].

### Statistical Analysis

For descriptive analysis, continuous variables were expressed as mean±SD or median, and categorical variables were expressed as percentages. The denominator of categorical variables was the number of participants with available data. Between-group comparison was tested using $X^2$ test for categorical variables and Spearman correlations and Pearson correlations were used to determine relationships between the independent and dependent variables. Missing data were not imputed, and participants with missing data for a variable were not be included in the analysis involving that particular variable.

## Results

Table 1 depicts the demographic composition of the sample study; 21 participants; age ranged from 66-90 years (mean age 74.9±6.75), 42% were male (n=9) and 51.7% female (n=12) were predominately white (n=16, 76.2%) followed by Black (n=5, 23.8%). One participant was bedbound, nine participants were from congregate sites, and 12 lived in their own homes. A total of 19 different chronic conditions (data not shown) were reported; rheumatoid and/or osteoarthritis was the highest reported chronic condition (n=10, 47.6%) of the participants followed by hypertension (n=9, 42.9%), hyperlipidemia (n=8, 38.1%), retinopathy and cancer (n=7, 33.3%). Using a Pearson's correlation, there was no significant relationship (p=0.944) between average blood glucose levels and the sum of co-morbidities.

| Variables | n (%) | Mean±SD |
|---|---|---|
| **Gender** | | |
| Male | 9 (42.9) | N/A |
| Female | 12 (57.1) | |
| **Ethnicity** | | |
| White | 16 (76.2) | N/A |
| Black | 5 (23.8) | |
| **Marital Status** | | |
| Married | 2 (9.5) | N/A |
| Single | 5 (23.8) | |
| Divorced | 7 (33.3) | |
| Widowed | 7 (33.3) | |
| **Education** | | |
| Primary (8th grade) | 2 (9.5) | 13.65±2.91 |
| High School (9-12th) | 6 (28.6) | |
| Undergraduate (13-16th) | 11 (52.4) | |
| Post-Grad (>17 years) | 2 (9.5) | |
| **Age (years old)** | | |
| 66-76 | 12 (57.1) | 74.9±6.75 |
| 77-90 | 9 (42.9) | |

**Table 1:** Demographic Characteristics of Study Population (N=21).

### Perception of Health

Participants were asked to rate how they perceived their general health. The majority of participants rated their health as "Good" (n=9, 42.9%) followed by "Fair" (n=7, 33.3%) with a mean of 3.33±.97. Similarly, when asked about symptom management pertaining to health within the past two weeks (e.g., "Were you discouraged by your health problems?" "Was your health a worry in your life?"), the mean score was 0.967±1.15. Of the participants, 42.8% reported symptom disruption as "None of the time" suggesting the majority of participants considered their diabetes and/or other co-morbidities to be well managed. Interestingly, there was not a significant correlation between general health ranking and symptom management scores (r=0.229, p=0.317). With regards to confidence about controlling health problems and abilities to control health, the mean score of confidence of self-care abilities was 7.26±1.89 on a scale of 10 (10 indicating full confidence). Of the 21 study participants, 52% reported having "Full confidence" in the self-care abilities and 29% reported moderate confidence. There was no significant correlation between general health rating and confidence (r=-0.319, p=0.158) or symptom management and confidence (r=-0.329, p=0.146). There was a significant correlation between general health and asking the physician questions about information that the participant did not understand or would like to learn (r=0.472, p=0.031). Incidentally, there was also a significant correlation between preparing a list of questions and asking the physician those questions (r=0.451, p=0.040). This may be due to the preparation of the list which might have reduced the anxiety of a physician appointment and the risk of forgetting questions.

The Diabetes Self-Management Questionnaire (DSMQ) was used to assess self -care activities associated with blood glucose control among each participant. The total sum of the 16- question survey ranged from 10 to 27 with an average of 20.43±3.96. There are four subcategories of the DSMQ: glucose management, diet control, healthcare and physical activity. Scores for general management ranged from 3 to 11 with an average of 7.67±2.67. Diet control scores ranged from 4 to 9 with an average

of 6.33±1.32. Healthcare ranged from 2 to 6 with a mean of 3.24±0.768 and physical activity scores ranged from 0 to 6 with a mean of 2.38±1.93.

## Primary Blood Glucose Control Method

As shown in Figure 1, the primary method of blood glucose control among the 21 study participants was Self-Blood Glucose Monitoring (SBGM) followed by medication, diet, and insulin. Secondary methods of blood glucose control varied with SGBM and physical activity as number one followed by medication and insulin therapy. Of the reported primary blood glucose control methods, 9 (42.9%) were self-monitoring, 7 (33.3%) were using medication, 4 (19.0%) were using diet and 1 (4.8%) was using insulin therapy. Interestingly, four individuals who reported medication use as their primary method of blood glucose control actually had blood glucose levels above the 48 mmol/mol (140 mg/dL), which indicates uncontrolled blood glucose, whereas only three individuals who used medication as their primary method of blood glucose control were actually in the target range of <48 mmol/mol (140 mg/dL). Chi-square tests were used for all reported primary methods of blood glucose to determine the relationship of blood glucose level of control. No significant differences were found due to the small difference between numbers of participants in each category with controlled versus uncontrolled blood glucose levels.

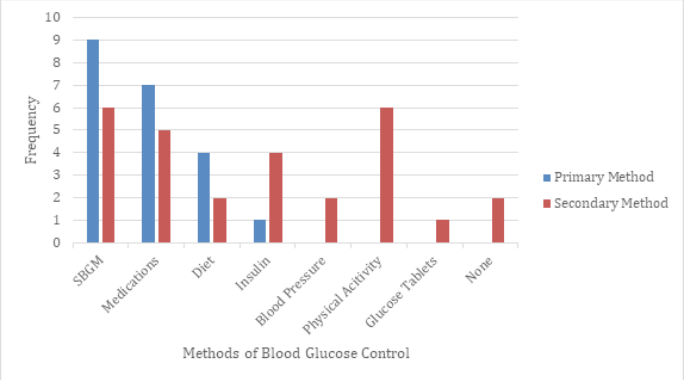


**Figure 1:** Comparison of Primary vs. Secondary Blood Glucose Control Methods (N=21).

## Primary Blood Glucose Control Method and Blood Glucose Level

The average blood glucose level among the study population was 49 mmol/mol (6.6%, 144.5±39.1 mg/dL), which is higher than the target goal of <48 mmol/mol (6.5%, 140 mg/dL) for older adults with diagnosed diabetes. Table 2 depicts the frequency, mean, and standard deviation when comparing primary methods of reported blood glucose control methods to blood glucose levels. Of the primary blood glucose methods reported, participants utilizing dietary intervention had more controlled blood glucose levels than those who utilized self-monitoring or medications. Controlled blood glucose was defined as <48 mmol/mol (6.5%, 140 mg/dL), whereas uncontrolled was ≥48 mmol/mol (6.5%, 140 mg/dL). Overall, 11 (52.4%) participants had controlled blood glucose levels while 10 (47.6%) had uncontrolled blood glucose levels according to this classification. Chi-square tests indicated when comparing SBGM with those who had controlled versus uncontrolled blood glucose levels, five individuals had controlled blood glucose compared with four who had uncontrolled blood glucose levels. There was no significant relationship between SBGM and blood glucose levels (p=0.623). Of the four participants using diet as their primary method of blood glucose control, one reported uncontrolled blood glucose levels and three reported levels within the normal limits. No significant relationship (p=0.586) was found between the use of dietary management as a primary method of control and blood glucose level.

| Variable | n (%) | Mean±SD of Blood Glucose Level |
|---|---|---|
| Self-Monitoring | 9 (42.9) | 146.54±.49.97 |
| Medications | 7 (33.3) | 145.29±31.54 |
| Diet | 4 (19.0) | 101.00±73.91 |
| Insulin | 1 (4.8) | 150.00±0.00 |
| Blood Pressure | 0 (0) | 0 |
| Physical Activity | 0 (0) | 0 |

**Table 2:** Primary Blood Glucose Method vs. Blood Glucose Levels (N=21).

## Performance of ADLs and IADLs

The extent to which older adults are able to perform activities of daily living (ADLs) produced strong results with a mean score of (5.67±0.913). The maximum score on the ADL screen was six, indicating full independence with bathing, dressing, toileting, transferring from bed/chair, continence, and eating. In contrast, the average score for instrumental Activities of Daily Living (IADLs) was 5.95±1.86, suggesting a moderate ability to function independently. The maximum score for the IADL is eight, indicating highly functioning independence for activities such as using the telephone, shopping, cooking, housekeeping, laundry, transportation, medications and financial matters. As shown in Table 3, all (n=21, 100%) study participants were independent in using the telephone and eating.

| ADL Variable | Mean±SD | Number of Independent (n (%)) | Number of Dependent (n (%)) |
|---|---|---|---|
| Dressing | .952±.218 | 20 (95.2) | 1 (4.8) |
| Toileting | .952±.218 | 20 (95.2) | 1 (4.8) |
| Transferring | .952±.218 | 20 (95.2) | 1 (4.8) |
| Continence | .904±.301 | 19 (90.5) | 2 (9.5) |
| Eating | 1±0 | 21 (100) | 0 (0) |
| Bathing | .904±.301 | 19 (90.5) | 2 (9.5) |

| IADL Variable | Mean±SD | Number of Independent (n (%) | Number of Dependent (n (%) |
|---|---|---|---|
| Using the telephone | 1±0 | 21 (100) | 0 (0) |
| Shopping | .476±.512 | 10 (47.6) | 11 (52.4) |
| Cooking | .428±.507 | 9 (42.9) | 12 (57.1) |
| Housekeeping | .857±.358 | 18 (85.7) | 3 (14.3) |
| Laundry | .667±.483 | 14 (66.7) | 7 (33.3) |
| Transportation | .619±.498 | 13 (61.9) | 8 (38.1) |
| Medication | .952±.218 | 20 (95.2) | 1 (4.8) |
| Finances | .952±.218 | 20 (95.2) | 1 (4.8) |

**Table 3:** ADL and IADL Subcategories and Participant Independence (N=21).

### ADL Performance and Blood Glucose level

Although, the average ADL score was 5.67±0.913, there was no significant correlation between the ADL score and blood glucose control (r =-0.094, p=0.686) using a Pearson's correlation. Similarly, there was no significant correlation between the IADL score (5.95±1.86) and blood glucose levels (r =-0.141, p=0.542). Interestingly, there was a significant correlation between the ADL and IADL scores (r= 0.492, p=0.024). This suggests that the higher the ADL score, the more likely an individual is to have a high IADL score as well.

### Depression and Blood Glucose level

Eighteen participants scored in the 0-5 category, two participants were suggestive of depression, and only one individual fell into the category of ≥ 10. The Spearman's correlation test showed no significant relationship between the depression score and blood glucose level (r = 0.213, p=0.354), suggesting that the presence or absence of depression is not related to an individual's glucose level. The results suggest that the majority of the study population may not be depressed.

### Depression and ADL/IADL Performance

Using a Pearson's correlation, no significant relationship (r = -0.147, p=0.524) was found between depression and ADL. Similarly, no significant relationship was found for depression and IADL (r= 0.016, p= 0.944).

## Conclusion

According to the American Diabetes Association's (ADA) Standards of Care, there are two techniques for health providers and patients to assess the effectiveness of the diabetes management plan of glycemic control: patient self-monitoring of blood glucose and $HbA_{1c}$. The ADA recommends self-monitoring of blood glucose while receiving on-going evaluation of self-monitoring techniques and blood glucose results. Due to the inability to leave the home (leaving the home requiring extra assistance), some homebound older adults with Type 2 diabetes do not have regular access to medical care. Thus, they are unable to see healthcare providers for routine evaluations of self-monitoring and $HbA_{1c}$ testing. The ADA found that individuals with diagnosed Type 1 diabetes who tested their blood glucose at least five times per day had significantly lower $HbA_{1c}$ levels and reduced complications with diabetes [15]. This same idea can be transferred to individuals with Type 2 diabetes; those who more frequently monitor their blood glucose levels are less likely to have large fluctuations in their blood glucose concentrations and are less likely to have bouts of hyperglycemia that put them at higher risk for diabetes-related complications.

It was originally thought that the data collected would suggest that self-monitoring of blood glucose as the primary method of control would provide significantly more controlled glucose levels than diet, physical activity, or use of pharmacologic agents. However, the data did not provide a significant relationship between method of blood glucose control and blood glucose levels, nor with blood glucose levels and ability to perform ADLs and IADLs, nor with blood glucose levels and depression. Diet therapy provided the most controlled blood glucose levels than any of the other primary reported methods. No significant relationship was found between depression and ability to perform ADLs or IADLs, as was expected. The study did find a significant relationship between asking the questions about health and participant perception of general health.

Schoitz et al. found participants with frequent contact with peers found had a positive assessment of self-management behaviors. In contrast, those reporting poor-functioning social networks were associated with a negative assessment of care [12]. Together, cognitive impairment and lack of social support may result in poor self-care activities to manage blood glucose. Close blood glucose is necessary as among those with diabetes, 65% of deaths are due to heart disease or stroke and 28.5% of individuals with diabetes have diabetes-induced retinopathy and other co-morbidities. The findings of the current study indicated moderately well controlled blood glucose levels, which may be attributed to the reported moderate ability to utilize self-care activities in regards to blood glucose and were from congregate meal sites where social contact was apparent and were not specifically homebound and isolated.

Little education is provided to the homebound older adult population due to Medicare restrictions on diabetes self-management training. Currently, a written order from a doctor or other healthcare provider for Medicare users allows them to receive 10 hours of outpatient diabetes training. Beneficiaries may receive up to two hours of follow-up training each year if the training is in a group setting, lasts for at least 30 minutes, is part of a doctor's order, and is within a calendar year after the year of initial training [19]. Areas for exploration may include actual knowledge of diabetes self-care and/or nutrient analysis of supplemental meal

programs. There is currently no congressional policy on requiring mandatory provision for disease-specific meals for populations dependent on these programs. Thus, should have a Registered Dietitian or Nutritionist on staff to help create meal plans.

## Strength/Limitations

The study is one of the first to address a wide range of social and health concerns of older homebound adults living with Type 2 diabetes. It shows the need for creating diet-specific meals for individuals with diabetes by programs that serve this population. The method of data collection was suitable for the homebound population [20], which was the target of this study, because the researcher was able to meet with them in their homes. This study sets the framework for further investigation into the specific methods of blood glucose control. The primary limitation is a small sample size (n=21). This limitation can alter effect size, p-values, confidence intervals and create disproportionate generalization when analyzing frequency data. The results from the current study cannot be generalized to multiple populations due to the limited size and limited ethnic variations.

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