Use of Community Support Services and Activity Limitations Among Older Adults With Chronic Kidney Disease

Bamini Gopinath, David C. Harris, George Burlutsky, and Paul Mitchell

Background. There is a lack of population-based data on associations between chronic kidney disease (CKD) and the functional status/independence of older adults. We assessed prospective associations between CKD and (a) use of community support services and/or reliance on nonspouse family/friend support and (b) activities of daily living measures among older adults.

Methods. A total of 1,952 participants from the Blue Mountains Eye Study aged 50 years or older at baseline were examined between 1992–1994 and 2002–2004. CKD was defined as Modification of Diet in Renal Disease Study estimated glomerular filtration rate of less than 60 mL.min\(^{-1}\)·1.73\(^{-1}\)·m\(^{-2}\). Use of services and nonspouse family/friend support was self-reported at baseline and follow-up. Functional status was determined by the Older Americans Resources and Services activities of daily living scale.

Results. After adjusting for age, sex, education level, receipt of pension, living status, poor self-rated health, hypertension, diabetes, number of hospital admissions, walking disability, and visual impairment, participants with CKD had increased odds of using community support services, odds ratio, 1.75 (95% confidence interval: 1.06–2.89). With increasing severity of CKD at baseline, the likelihood of using community support services 10 years later increased significantly, \(p_{\text{trend}} = .02\). After multivariable adjustment, participants with CKD had a greater likelihood of incident impaired instrumental activities of daily living after 10 years, odds ratio, 2.02 (95% confidence interval: 1.15–3.57). Increasing severity of CKD at baseline was associated with increased likelihood of incident impaired instrumental activities of daily living, \(p_{\text{trend}} = .02\).

Conclusions. CKD could be a potential barrier to independent living for older adults, as shown by the increased need for formal home care services.

Key Words: Chronic kidney disease—Activities of daily living—Older adults—Blue Mountains Eye Study—Support services.

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CHRONIC kidney disease (CKD) is common in older people and is thus, emerging in the 21st century as a global public health issue (1). Although a link between CKD and limitations in mobility has been found (2), it is surprising that there are limited epidemiological data available on the relationship between CKD and difficulty in carrying out activities of daily living (ADL). In the spectrum of disability, inability to perform instrumental ADL (IADL, ie, those activities required to function in the community such as shopping) and basic ADL (BADL, eg, eating and washing) often precedes dependency and provides important prognostic information (3). One of the few studies to assess the link between CKD and ADL difficulty was a U.S. prospective study of 357 participants (mean age 77.4 years). This study showed that baseline CKD stage 3B or greater (<45 mL.min\(^{-1}\)·1.73 \(m^2\)) was associated with a threefold higher risk of decline in IADL and BADL, 2 years later (3). A recent study of 97 patients aged 80 years or older, showed that initiation of dialysis resulted in functional loss that required community or private caregiver support or transfer to a nursing home (4).

To our best knowledge, the contribution of CKD to use of community support services or need for regular help from nonspouse family and/or friends has not been assessed in a population-based setting. Understanding the contribution (if any) of CKD to the type and extent of home care services, both formal (community support services) and informal (nonspouse family/friend) support is needed. These epidemiological data could assist in long-term planning of health services and policies (5).
Using this relatively large cohort of adults aged 55 years and older, we aimed to investigate two questions: (a) Does the presence of renal dysfunction increase the likelihood of receiving support from community support services and/or nonspouse family or friends 10 years later? and (b) Is there a cross-sectional and longitudinal association between CKD and functional status as assessed by an ADL scale?

**Methods**

**Study Population**

The Blue Mountains Eye Study (BMES) is a population-based cohort study of common eye diseases and other health outcomes in a suburban Australian population located west of Sydney. Study methods and procedures have been described elsewhere (6). Baseline examinations of 3,654 residents aged more than 49 years were conducted during 1992–1994 (BMES-1, 82.4% participation rate). Surviving baseline participants were invited to attend examinations after 5- (1997–1999, BMES-2), 10- (2002–2004, BMES-3), and 15 years (2007–2009, BMES-4) at which 2,335 (75.1% of survivors), 1,952 (75.6% of survivors), and 1,149 (55.4% of survivors) participants were reexamined, respectively, with complete data. The University of Sydney and the Western Sydney Area Human Ethics Committees approved the study, and written informed consent was obtained from all participants at each examination.

**Assessment of CKD**

At all four BMES examinations, serum creatinine was measured within 4 hours of fasting venous blood collection using a Hitachi 747 biochemistry analyzer (Roche Diagnostics, Castle Hill, Sydney, New South Wales, Australia). Serum creatinine data from 2003 to 2004 (BMES-3) was measured in an isotope dilution mass spectrometry (IDMS) aligned version of the assay. However, BMES-1 serum creatinine was not IDMS aligned. Therefore, we applied a correction to BMES-1 serum creatinine data to bring the assay results into alignment with IDMS. The approach taken was to use the known conversion factors supplied by Roche from the Roche Jaffe rate-blanked uncorrected assay and the same assay with correction. The “correction” referred to is to bring the assay into alignment with IDMS. The correction is a mathematical one based on value assignment of the calibrators and subtraction of a factor. BMES-1 creatinine data have been converted to IDMS equivalent results using the formula: Creatinine (IDMS) = creatinine (BMES-1) × 1.086 – 26 µmol/L.

Estimated glomerular filtration rate (eGFR) was the preferred measure of kidney function in this study. Glomerular filtration rate (GFR) was indirectly estimated using the four-variable Modification of Diet in Renal Disease Study (MDRD) equation: GFR (mL min\(^{-1}\)·1.73 m\(^{-2}\)) = 186 × (serum creatinine\(^{-1.154}\) × (age\(^{-0.203}\) × (0.742 if female)) (conventional units [7]). The main outcome of interest was CKD of stage 3 or greater, defined as an eGFR of less than 60 mL min\(^{-1}\)·1.73 m\(^{-2}\). We also looked at the severity of CKD, stratified as the following: stage 3A as eGFR = 45–59 mL min\(^{-1}\)·1.73 m\(^{-2}\); stage 3B as eGFR = 30–44 mL min\(^{-1}\)·1.73 m\(^{-2}\); and stage 4 or 5 as eGFR = ≤29 mL min\(^{-1}\)·1.73 m\(^{-2}\).

**ADL Scale**

The Older American Resources and Services (OARS) ADL scale (8) includes 14 items: seven items assess BADL (eating, dressing and undressing, grooming, walking, getting in and out of bed, bathing, and toileting) and seven items assess IADL (using the telephone, travel, shopping, meal preparation, housework, taking medicine, and management of finances). The OARS ADL scale was only administered at the 10-year (2002–2004) and 15-year BMES examinations (2007–2009). Each item was rated on a 3-point scale: performs the activity without help (2) performs the activity with some help (1), or completely unable to perform the activity (0), hence, the higher the score, the more independent the person is. Three summary scales were computed by summing the scores of items: (a) a total score, the sum of all 14 items (range 0–28), (b) a BADL score, the sum of the 7 BADL items (range 0–14), and (c) an IADL score, the sum of the 7 IADL items (range 0–14). Participants reporting that they needed help with any of the activities or were completely unable to perform any of the activities were considered to have impaired ADL.

**Community Support Services and Informal Support**

Use of community support services and informal support were ascertained at all four BMES examinations. For the current report, we have used formal and informal support data collected at BMES-1 and then 10 years later at BMES-3. To assess use of community support services and dependence on informal supports, participants were asked the following questions:

- Do you get regular help from Meals on Wheels?
- Do you get regular home visits from a community nurse?
- Do you get regular visits from Homecare?
- Who usually cleans your house (you, spouse, daughter, son, other relatives, home help, others)?
- Who usually does your shopping (same choices as earlier)?
- Are you able to go out alone?

Dependence on community support services was defined as regular use of Meals on Wheels, Homecare, or community nursing. Reliance on informal support was defined as receiving assistance from someone other than a spouse (family member/friend) for cleaning or shopping. In addition, participants’ ability to go out alone was also assessed.
**Information on Covariates**

At face-to-face interviews with trained interviewers, information about socioeconomic characteristics was obtained from all participants and their medical history and lifestyle factors such as smoking. Level of education obtained was also ascertained and classified as lower than tertiary (ie, did not attain any qualifications past high school) or tertiary and higher. Participants were also asked whether they received a pension and if so, the type of pension they were receiving, for example, age, invalid, veteran’s, or blind. Participants self-reported history of smoking as never, past, or current smoking. Current smokers included those who had stopped smoking within the past year. Body mass index was calculated as weight divided by height squared (kg/m²). Criteria for a diagnosis of diabetes were self-reported diabetes history and current use of diabetic medications or a fasting plasma glucose concentration of greater than or equal to 7.0 mmol/L (9). Participants were defined as having hypertension if they had systolic blood pressure greater than 140 mm Hg or diastolic blood pressure of more than 90 mm Hg or were on antihypertensive medications (10).

Self-rated health was assessed by asking “for somebody your age, would you say your health is excellent, very good, good, fair, or poor?” Low self-rated health was defined as fair or poor. Walking difficulty or use of a cane, walker, or wheelchair was observed by a trained examiner and categorized as “disability in walking.” Visual acuity was measured wearing current glasses, using a LogMar chart, and was followed by subjective refraction (6). For each eye, visual acuity was recorded as the number of letters read correctly from 0 (<6/60) to 70 (6/3). Visual impairment was defined as visual acuity of less than 39 letters (<6/12) in the better eye after subjective refraction. Cognitive function was assessed using the Mini-Mental State Examination administered at both the baseline and follow-up visits. Mini-Mental State Examination scores range from 0 to 30 (11), with scores less than 24 indicating cognitive impairment. The 10-item version of the Center for Epidemiologic Studies Depression-10 scale measures depressive feelings and behaviors experienced in the past week (12). Each of the 10 items is coded on a scale of 0–3 to give a maximum of 30 points (13). Higher scores indicate a greater burden of depressive symptoms. A cutoff score of greater than or equal to 10 out of a total possible score of 30 was used to define participants with significant depressive symptoms (12).

**Statistical Analysis**

SAS statistical software (SAS Institute, Cary, NC) version 9.1 was used for analyses including t tests, \( \chi^2 \) tests, and logistic regression. Multivariable logistic regression analysis was used to calculate adjusted odds ratios (OR) and 95% confidence intervals (CI) to demonstrate the association between CKD (dependent variable) with impaired ADL and use of community support services or reliance on support from nonspouse family or friends (independent variables), whereas adjusting for confounders. Logistic regression models first adjusted for age and sex, and additional confounders were also adjusted for. Potential confounders that were assessed included various sociodemographic factors (eg, receipt of pension, education level), as well as body mass index, smoking, serum triglycerides and total cholesterol, and several medical conditions (eg, hypertension, diabetes). Only those potential confounders that significantly modified the effect of CKD in age–sex adjusted models, or significantly predicted the outcome variable (ie, either support service usage or impaired ADL), were included in subsequent multivariable analyses. For support service usage analyses, potential confounders that satisfied one or more of the earlier criteria and so were included in the final, parsimonious model were education level, receipt of pension, living status, poor self-rated health, hypertension, diabetes, number of hospital admissions, walking disability, and visual impairment. For ADL analyses, potential confounders that satisfied one or more of the earlier two criteria and so were included in multivariable analyses were living status, self-rated poor health, smoking, body mass index, hypertension, diabetes, hospital admissions in the past year, walking disability, probable depression, and Mini-Mental State Examination scores. Significance was taken as \( p < .05 \).

**Results**

**Association Between CKD and Use of Formal and Informal Support**

At BMES-1 (baseline), 3,134 of the 3,654 persons examined had serum creatinine measured as well as information on support services usage. Baseline characteristics of participants included for support service usage analyses is shown in Supplementary Table 1. Participants with CKD versus no CKD were more likely to be older adults, living alone, visually impaired, admitted to hospital in the past year, and have a walking disability, hypertension and diabetes, but less likely to be men and tertiary qualified. Of these, 153 (4.9%) participants self-reported using community support services.

CKD stage 3 or worse was cross-sectionally associated with an increased likelihood of using community support services, multivariable-adjusted OR, 1.64 (95% CI: 1.07–2.51; Table 1). Participants with versus without any CKD were more likely to use informal support from nonspouse family member/friend, OR, 1.08 (95% CI: 0.75–1.57). A significantly increased likelihood of using community support services was observed with increasing severity of CKD (\( p_{\text{trend}} = .04 \); Table 1).

Of the 1,952 survivors examined after 10 years, 1,391 had serum creatinine data at baseline and support service usage for more than 10 years. We compared baseline
Table 1. Cross-Sectional Association Between Chronic Kidney Disease (CKD) and the Prevalence of Use of Community Services and Family/Friend Support at the Baseline Blue Mountains Eye Study (BMES) in 1992–1994 (n = 3,134)

<table>
<thead>
<tr>
<th>Presence of CKD</th>
<th>Type of Support, OR (95% CI)</th>
<th>Without CKD, n = 2,665</th>
<th>Age–sex adjusted</th>
<th>Multivariable adjusted†</th>
<th>Without CKD, n = 1,270</th>
<th>Age–sex adjusted</th>
<th>Multivariable adjusted†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 3A CKD, n = 289</td>
<td>Community support services</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
</tr>
<tr>
<td>Stage 3B CKD, n = 107</td>
<td>Community support services</td>
<td>1.76 (1.16–2.67)</td>
<td>1.03 (0.70–1.50)</td>
<td>1.00 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
<td>1.0 (reference)</td>
</tr>
<tr>
<td>Stage 4 or 5 CKD, n = 20</td>
<td>Community support services</td>
<td>1.74 (0.94–3.25)</td>
<td>1.14 (0.64–2.03)</td>
<td>1.15 (0.55–2.33)</td>
<td>0.83 (0.44–1.60)</td>
<td>1.13 (0.55–2.33)</td>
<td>0.83 (0.44–1.60)</td>
</tr>
<tr>
<td>Stage 5 CKD, n = 10</td>
<td>Community support services</td>
<td>2.16 (1.06–4.47)</td>
<td>2.49 (0.88–7.09)</td>
<td>3.15 (0.78–12.64)</td>
<td>2.34 (0.67–8.17)</td>
<td>3.15 (0.78–12.64)</td>
<td>2.34 (0.67–8.17)</td>
</tr>
</tbody>
</table>

Notes: CI = confidence interval; OR = odds ratio.
†Further adjusted for education level, receipt of pension payment, living status, self-rated poor health, hypertension, diabetes, hospital admissions in the past year, walking disability, and best-corrected visual impairment.

Table 2. Longitudinal Association Between Chronic Kidney Disease (CKD) and incidence of use of community services and family/friend support in the baseline Blue Mountains Eye Study (BMES) from 1992–1994 to 2002–2004 (n = 1,391)

<table>
<thead>
<tr>
<th>Presence of CKD</th>
<th>Type of Support, OR (95% CI)</th>
<th>Without CKD, n = 1,270</th>
<th>Age–sex adjusted</th>
<th>Multivariable adjusted†</th>
<th>Without CKD, n = 1,270</th>
<th>Age–sex adjusted</th>
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<td>Community support services</td>
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<td>1.63 (0.99–2.67)</td>
</tr>
<tr>
<td>Stage 4 or 5 CKD, n = 20</td>
<td>Community support services</td>
<td>2.15 (1.34–3.44)</td>
<td>1.91 (1.20–3.05)</td>
<td>2.15 (1.34–3.44)</td>
<td>1.91 (1.20–3.05)</td>
<td>2.15 (1.34–3.44)</td>
<td>1.91 (1.20–3.05)</td>
</tr>
<tr>
<td>Stage 5 CKD, n = 10</td>
<td>Community support services</td>
<td>1.80 (1.06–3.05)</td>
<td>1.86 (1.12–3.10)</td>
<td>1.80 (1.06–3.05)</td>
<td>1.86 (1.12–3.10)</td>
<td>1.80 (1.06–3.05)</td>
<td>1.86 (1.12–3.10)</td>
</tr>
</tbody>
</table>

Notes: CI = confidence interval; OR = odds ratio.
†Further adjusted for education level, receipt of pension payment, living status, self-rated poor health, hypertension, diabetes, hospital admissions in the past year, walking disability, and best-corrected visual impairment.

Characteristics of participants (n = 1,391) versus those who had died (n = 573) during the 10 years and observed that participants who had died compared with survivors were more likely to be older (73 vs 63 years), male (55% vs 40%), visually impaired (8% vs 1%), living alone (33% and 23%), admitted to the hospital in the past year (31% vs 18%), have used community support services (5% vs 1%), and informal support (15% vs 5%), CKD (28% vs 9%), walking disability (16% vs 2%), poor self-rated health (37% vs 17%), hypertension (56% vs 39%), and diabetes (12% vs 6%), all p < .0001.

Table 2 shows the longitudinal association between baseline CKD and incident use of support services. There were 156 (11.2%) incident cases of community support service usage. After multivariable adjustment, participants with eGFR of less than 60 mL min⁻¹·1.73 m⁻² had 75% increased odds of incident use of community support services. With increasing severity of CKD at baseline, the likelihood of using community support services also increased significantly (Table 2). There was a marginally nonsignificant trend observed between increasing severity of CKD and incident use of informal support (multivariable-adjusted pₚₑₚₑₚₑ = .07).

Association Between CKD and Impaired ADL

Of the 1,952 participants examined at BMES-3, 1,328 had serum creatinine and complete ADL data. Baseline characteristics of participants included for ADL analyses is shown in Supplementary Table 2. Participants with CKD versus no CKD were more likely to be older, female, living alone, heavier, admitted to hospital in the past year, and have poor self-rated health, walking disability, hypertension, and diabetes.

Compared with persons with normal eGFR, a significantly higher proportion of persons with eGFR of less than 60 mL min⁻¹·1.73 m⁻² reported difficulties in performing two out of the seven BADL and four out of the seven IADL tasks (Table 3). Highly significant differences were observed in the frequency of those with and without CKD reporting difficulties in the following IADL: (a) Can you go shopping for groceries or clothes? (b) Can you prepare your own meals? and (c) Can you do your housework? (Table 3). One hundred and twenty-two (9.2%) participants self-reported having impaired IADL. Increasing severity of CKD was cross-sectionally associated with impaired IADL (multivariable-adjusted pₑₑₑₑₑₑ = .02; Table 4). Those with CKD stage 3B versus those without CKD were twice as likely to have difficulties in performing IADL (Table 4). Significant associations were not observed with BADL (data not shown).

Among participants with eGFR of less than 60 mL min⁻¹·1.73 m⁻² at BMES-3, 35 (46.7%) had incident IADL 5 years later at BMES-4, compared with 40 (53.3%) among those with normal renal function at BMES-3. After multivariable adjustment, having any CKD was associated with a twofold increased likelihood of incident impaired IADL, OR, 2.02 (95% CI: 1.15–3.57). A significant increase
in incident IADL was observed with increasing severity of CKD ($p_{\text{trend}} = .02$); compared with participants with no CKD at baseline those with stage 3A and 3B CKD had the following odds: OR, 1.96 (95% CI: 1.05–3.66) and OR, 2.29 (95% CI: 0.74–7.12), respectively. CKD was not associated with incident impaired BADL (data not shown).

**Discussion**

To our best knowledge, this is the largest cohort of older adults to determine the association between CKD and use of support services as well as difficulties in performing IADL. We present novel epidemiological evidence showing that older adults with CKD had a 75% increased likelihood of using community support services (such as Meals on Wheels and visits from community nurse). We also show that participants with CKD at baseline had a twofold higher likelihood of experiencing difficulty with IADL (such as shopping and housework) 5 years later.

Novel findings from our study include the prospective association between baseline CKD and use of support services 10 years later and that these associations appear to be stronger in persons with more advanced CKD. The observational nature of this study precludes us from establishing the causal mechanisms that underlie the link between CKD and increased reliance on community support.
services. However, several potential pathways can be hypothesized. First, previous studies have shown that ADL and IADL limitations are important predictors of need for home help in older people (5,14). Activities such as being able to walk, going shopping for groceries, preparing ones meals are considered to be important to maintain functional independence and were some of the activities that BMES participants with CKD expressed difficulty in performing. Hence, given that we and others have shown significant relations between CKD and impaired IADL (2,3), the temporal link between CKD and increased reliance on formal and informal support services could be at least in part due to physical or ADL disability. We need to caution, however, that we did not have data on cognitive function or macroenvironmental variables (eg, societal factors) at the baseline study (BMES-1), both these factors have shown to be associated with support service utilization (5,14). Therefore, we cannot exclude the possibility of residual confounding from these unmeasured factors.

We also need to highlight that dependence on formal support services is not necessarily an adverse outcome. This type of community support can maintain older adults in the community for longer and/or delay their nursing home admission, hence, this could reduce the cost of geriatric care appreciably (15,16). Moreover, such social support has been shown to maintain a better health-related quality of life and improve self-rated health (17,18). Even so, our finding that participants with even moderate CKD or stage 3A were predisposed to an increased reliance on formal support services in the long term, suggests that nephrologists and CKD guidelines in general, which thus far, have focused on traditional outcomes such as progression of CKD, cardiovascular events and mortality, should make a greater effort to address the goal of maintaining independence as this could be a more meaningful outcome for the many older adults with CKD (18).

Participants with CKD had difficulty performing IADL tasks more so than BADL tasks; in particular, CKD impaired the ability to perform housework, prepare ones’ meals, and to go shopping for groceries and clothes. The temporal association between CKD and functional disability (as defined by significantly lower IADL scores) concur with previous findings in community-dwelling older adults (2,3). There are several biologically plausible pathways to explain the observed association. Inflammatory markers are known to be elevated in CKD (19), and inflammation in turn has been associated with the development of incident mobility disability, likely due to a decline in muscle strength (2,20). Therefore, the relationship between CKD and reduced ability to perform ADL could be at least in part, mediated by an inflammatory pathway. Alternatively, CKD could be a marker for other factors associated with loss of independence including anemia, bone and mineral disorders, and neuropathy (3). Hence, these multiple CKD comorbidities could negatively impact on functional ability, leading to impaired IADL in older adults with kidney dysfunction (3).

The significant association observed between severity of CKD and impaired IADL observed not only in our cohort but in prior studies (2,3) highlights that those at risk of CKD (eg, family history, diabetes) or in the initial stages of renal dysfunction could be targeted for earlier identification and intervention to limit the development of functional disability (21). Specifically, exercise training has been shown to improve physical function in dialysis patients (22), hence, this deserves further study in persons with CKD not requiring dialysis to determine whether it can slow or prevent functional limitation and the consequent spiral toward disability (2).

Strengths of our study include its population-based sample of relatively large size, high participation rates, and availability of rich confounder information. We had limited data collected on services utilization; for example, questions were not asked about the frequency and duration of support service usage, also older people may often be confused about which agency provided a service. These factors could have limited the accuracy of our measurements and contribute to measurement error. However, such error is likely to cause a bias toward the null, hence, our findings may be an underestimate (18). Another limitation is that we used a survivor cohort, we observed significant differences in baseline characteristics between survivors and nonsurvivors, hence, those with CKD could have died before support service usage and ADL disability was documented at the follow-up examinations, as such, we could have underestimated the associations between CKD with support service usage and impaired ADL. Finally, the BMES was designed to examine issues of sensory loss and not kidney function per se. As such, we do not have urinalysis data and proteinuria information; however, we have estimated renal function

Table 4. Cross-Sectional Association Between Chronic Kidney Disease (CKD) and Instrumental Activities of Daily Living (IADL) at Blue Mountains Eye Study (BMES) in 2002–2004 (n = 1,328)

<table>
<thead>
<tr>
<th>Presence of any CKD (&lt;60)</th>
<th>Impaired IADL: OR (95% CI)</th>
<th>Mean ADL Score (SD)</th>
<th>Multivariable adjusted*</th>
</tr>
</thead>
<tbody>
<tr>
<td>None, n = 1,070</td>
<td>26.9 (2.4)</td>
<td>1.0 (reference)</td>
<td>26.9 (2.4)</td>
</tr>
<tr>
<td>Any, n = 258</td>
<td>26.3 (2.8)</td>
<td>1.39 (0.98–1.98)</td>
<td>26.3 (2.8)</td>
</tr>
<tr>
<td>p value</td>
<td>&lt;.001</td>
<td>.07</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Severity of CKD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None, n = 1,070</td>
<td>26.9 (2.4)</td>
<td>1.0 (reference)</td>
<td>26.9 (2.4)</td>
</tr>
<tr>
<td>Stage 3A, n = 176</td>
<td>26.6 (2.6)</td>
<td>1.10 (0.74–1.66)</td>
<td>26.6 (2.6)</td>
</tr>
<tr>
<td>Stage 3B, n = 61</td>
<td>25.8 (3.2)</td>
<td>2.47 (1.28–4.78)</td>
<td>25.8 (3.2)</td>
</tr>
<tr>
<td>Stage 4 or 5, n = 21</td>
<td>25.3 (3.4)</td>
<td>2.15 (0.71–6.53)</td>
<td>25.3 (3.4)</td>
</tr>
<tr>
<td>p for trend</td>
<td>&lt;.0001</td>
<td>.02</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Notes: ADL = activities of daily living; CI = confidence interval; OR = odds ratio.

*Adjusted for age, sex, living status, self-rated poor health, smoking, body mass index, hypertension, diabetes, hospital admissions in the past year, walking disability, probable depression, and Mini-Mental State Examination scores.
using a widely accepted method. Nevertheless, limitations of such estimated measures of kidney function exist; specifically, serum creatinine is an insensitive marker of GFR in older adults, hence, it is not surprising that the MDRD formula based predominantly on it is imperfect. Therefore, eGFR should not be accepted without reservation as a reliable substitute for direct measurement of renal function (23).

In summary, participants with CKD and in particular more severe CKD, independent of potential confounders such as hospital admissions and walking disability, had a higher predisposition to require formal support services. Further, CKD was a significant predictor of experiencing difficulty in performing IADL tasks among older adults. These findings highlight the need for effective public health interventions that target older adults with CKD stage ≥3 or more, in order to preserve their functional independence and well-being in later life.

Funding

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Conflict of Interest

None to declare.

References