

Predictors of Mortality in Home Health Care Service: Data from Saudi Arabia

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Objective: This study aimed to 1) report the prevalence of chronic conditions among Saudi people receiving long-term home health care (HHC) services, 2) identify the predictors of mortality among individuals receiving long-term HHC services, and 3) study the association between frailty and poor health outcomes among HHC users.

Design: Retrospective cross-sectional descriptive study.

Setting and Participants: A total of 555 participants were recruited from HHC services at King Saud University Medical City (KSUMC), Riyadh, Saudi Arabia. We collected the data from electronic health records (EHR), patient charts, and caregiver interviews for 555 participants included in HHC program from the year 2019 to 2022.

Methods: Only individuals fulfilling the HHC program's eligibility criteria were included to the study. A total of 555 participants were included in the analysis. We assessed the functional performance by the Katz activity of daily living and Bristol Activity of Daily Living Scale (BADLS). A trained health care provider assessed frailty using the Clinical Frailty Scale (CFS). We calculated the means and frequency to describe the prevalence of chronic conditions and variables of interest. A Chi-square test or independent-samples *t*-test was run to determine if there were differences between the alive and deceased individuals. A binary logistic regression model was performed to predict mortality of HHC service recipients.

Results: The mean age for deceased individuals in HHC was 78.3 years. Over twenty percent of individuals receiving HHC services were readmitted to the hospital. We found that the strongest predictors for mortality were pressure ulcers with an odds ratio of 3.75 and *p*-value of <0.0001, and the Clinical Frailty Scale, which had an odds ratio of 1.69 and *p*-value of 0.002, using multivariate regression analysis.

Conclusions and Implications: In conclusion, our study found that pressure ulcers and frailty are the strongest predictors of mortality for individuals receiving home health care services.

Keywords: home health care, Saudi Arabia, predictors of mortality

Introduction

The home health care (HHC) service is a range of clinical and social services skilled workers provide to individuals in their own homes.¹⁻⁴ The main pillars of HHC programs are nursing care and basic medical assessment.⁴ Most recipients of HHC services are frail older adults and individuals living with a disability or functional decline.⁴ The duration of the Home Care (HC) services ranges from long-term service for chronic nursing care to limited services for short durations, eg, postoperative home care service. Regardless of the HHC program's type, setting, or recipient's characteristics, they mostly share a common goal of providing clinical care to improve the individual's quality of life and reduce hospitalization.⁴⁻⁸

The history of publicly funded HHC service in Saudi Arabia dates to 1991.⁹ The first HC program provided palliative home care service for patients with terminal cancer. After that, more programs were launched across Saudi Arabia, leading to the national program for HHC by the Ministry Of Health (MOH) in 2008. The national HHC MOH program mainly provides long-term care home care services for over 40,000 Saudi citizens. The scope of the HHC service program provided by the Saudi MOH is quite diverse, ranging from basic nursing care to specialized care programs, eg, home peritoneal dialysis, home ventilation, home infusion therapy, etc.

Currently, the Saudi MOH is going through a major reform in fulfillment of the national 2030 strategic vision of Saudi Arabia. According to the 2030 vision, the MOH will oversee and supervise both the public and private health care sectors. However, policymakers must review nationally reported quality performance measures and health outcome data to set best practice standards and regulatory measures. To date, very few studies and national reports address the prevalence of chronic conditions among the recipients of long-term HHC services in Saudi Arabia. Moreover, there is scarce data on the predictors of important health outcomes such as readmission, function decline, and mortality to set the national standard of care among the different care providers. Therefore, our study aimed to 1) describe the prevalence of chronic conditions among Saudi people receiving long-term HHC services, 2) identify the predictors of mortality among individuals receiving long-term HHC services, and 3) study the association of frailty among HHC users with poor health outcomes.

Methods

Design and Participants

We conducted a retrospective and cross-sectional, descriptive study for patients receiving HHC services at King Saud University Medical City (KSUMC), Riyadh, Saudi Arabia from 2019 to 2022 in the study. We collected the data from electronic health records (EHR), patient charts, and caregiver interviews from 2019 to 2022. We included all individuals fulfilling the HHC program eligibility criteria. The eligibility criteria for the HHC program are 1) individuals who are clinically stable at admission to HHC, 2) individuals with mobility impairment, 3) individuals with stable cognitive or behavioral disorders, 4) individuals requiring skilled clinical service, 5) homebound individuals due to either chronic condition, physical, cognitive, or behavioral disorder. The exclusion criteria were 1) individuals who did not require long-term HHC service such as home intravenous antimicrobial therapy recipient, 2) individuals who were clinically unstable during the time of admission to HHC, 3) individuals who declined the HHC more than 3 times, 4) individuals not living within the coverage area of the HHC program.

Ethics Approval

We obtained Human Research Ethics Committee approval from the KSU Institutional Review Board, reference number 21/0697/IRB project number KSU-IRB 017E. Our institutional policies waived informed consent for retrospective studies. We anonymized data before securing storage.

Sampling, Recruitment, and Study Procedures

KSUMC uses electronics health record to store patients' records, clinical notes, laboratory and imaging results. We reviewed all the charts for individuals admitted to a home health care program at the KSUMC from 2019 to 2021. A trained health care provider assessed frailty using the Clinical Frailty Scale (CFS).¹⁰ We limited the frailty assessment to older adults and excluded pediatric participants. We assessed functional performance by the Katz activity of daily living and the Bristol Activity of Daily Living Scale (BADLS).

Measurements: Outcomes and Predictors

We assessed the primary outcome, mortality, by reviewing the death certificates if patients were hospitalized or through discharge status ascertainment from EHR. The main functional predictors for mortality were measured by the Clinical Frailty Scale, BADLS, and KATZ.

Clinical Frailty Scale

The Clinical Frailty Scale was originally developed to be a 7-point scale ranging from very robust to severely frail.¹⁰ The scale was updated to include two additional points, 8 being completely dependent with severe frailty and 9 being terminally ill.¹¹ A trained clinician assessed the participant after reviewing their comorbidities and making an informed judgment about the participant's degree of frailty. The final score is then recorded in the participant's records and case record form.

BADLS

The BADLS is a functional assessment scale validated to assess the basic and instrumental activities of daily living for people with dementia. The BADLS was previously translated, cross-culturally adapted and validated for Arabic speaking people.¹² In this study we used the translated and validated Arabic version of the BADLS.¹³ After reading the instruction to the caregiver of the patient living with dementia, they are instructed to choose the current level of functional ability for each item. The scale consists of 20 items; responses are graded to describe the person's increasing dependence on performing basic and instrumental activities of daily living. The items assess the following daily activities: drink preparation, use of the telephone, food preparation, housework, communication, shopping, eating, orientation to space, games, and hobbies, dental care, hygiene, bathing, dressing, using the toilet, drinking, mobility, transferring, orientation to time, driving, using public, transport, and managing finances. Each item is scored from 0 (independent) to 3 (fully dependent), with the total score ranging from 0 to a maximum score of 60.

KATZ

The Katz Index of Independence in Activities of Daily Living is commonly referred to as the Katz ADL Index. The scale ranks adequacy of performance in the six functions of bathing, dressing, toileting, transferring, continence, and feeding. The caregivers also fill this scale. Individual items are scored "yes" or "no" for independence in each of the six functions. A score of 6 indicates full function, 4 indicates moderate impairment, and 2 or less indicates severe functional impairment.¹⁴⁻¹⁶ Thus, higher total scores indicate greater independence. The Katz ADL index was previously translated to Arabic.¹⁴ In this study we used the Arabic translated version to assess the basic activities of daily living.¹⁴

Statistical Analysis

We calculated the means and frequencies to describe the prevalence of chronic conditions and variables of interest. A Chi-square test or independent-samples *t*-test was run to determine if there were differences between the alive and deceased individuals for the categorical or continuous variables were appropriate. The statistical significance level was set to a *p* value < 0.05 (two-sided) and the FDR-adjusted *p*-values was calculated to adjust for multiple testing. We used binary logistic regression model to predict the probability that individuals were deceased using the following variables: presence of pressure ulcers, stroke, or cancer of any kind, patient age, clinical frailty score, and the number of days hospitalized. We used regression coefficients, standard error and odds ratios (ORs), 95% confidence intervals (CIs), and *p* values to quantify the associations between variables and study outcomes. The statistical significance level was set to a *p* value < 0.05 (two-sided). Model fit was estimated using the area under the curve (AUC) of the ROC curve and sensitivity and specificity.

Linear regression modeling was used to predict health outcomes in patients (BADLS and KATZ), with clinical frailty score as a predictor while controlling for age and the number of days hospitalized. Model fit was estimated using *R*². The variance inflation factor (VIF) for all predictors was calculated, and multicollinearity was deemed negligible (all VIF < 1.3). All statistical analyses were carried out with SPSS (IBM statistics SPSS version 28).

Results

Demographic and Health Characteristics of the Study Population

We accessed the electronic medical records for all HHC individuals. A total of 555 patients were included in the analysis the mean age of the study population was 75.58 years (range, 5–114 years), and 241 (43.4%) were males. Overall, 355

(63.9%) patients were alive, while 198 (35.6%) were deceased. [Table 1](#) summarizes the demographic and health characteristics of the participants. The most commonly diagnosed condition was hypertension, followed by diabetes. Our study found a high prevalence of mental health conditions among HHC service recipients, whereas the prevalence of dementia and depression was 34.43% and 26.38, respectively. There was no significant difference in the prevalence of chronic conditions between the alive and deceased group except for cancer diagnosis and the presence of pressure ulcers with p-values of 0.007 and less than 0.001, respectively. See [Supplementary Table 2](#) in [Supplementary Materials](#).

The Distribution of Chronic Health Conditions Among Saudi People Receiving Long-Term HHC Services

[Figure 1](#) shows the distribution of chronic health conditions among Saudi people receiving long-term HHC services. The most common health condition reported among HHC service recipients was hypertension, with 71.66% (n=392). Among those, 71% (n=250) were in the alive group and 72.7% (n=141) for the deceased group. Moreover, diabetes mellitus ranked second among HHC, with 66.36% of HHC recipients diagnosed with diabetes (n=363). The prevalence of diabetes was 67% (n=236) for the alive group and 126 (64.9%) for the deceased group. See [Supplementary Table 1](#) in [Supplementary Materials](#).

Table 1 Basic Demographics and Health Characteristics of Study Population

Variables		Frequency	Percent
Gender	Male	241	43.42
	Female	314	56.58
Marital status	Single	47	8.6
	Married	407	74.1
	Widowed	90	16.4
	Divorced	4	0.7
Education	Illiterate	260	66.8
	Literate > 4-year education	5	1.3
	Primary school education	28	7.2
	Intermediate	13	3.3
	High school	18	4.6
	College technical	29	7.5
	Postgraduate degree	36	9.3
Coronary artery Disease		112	20.51
Any cardiovascular disease		244	44.77
Stroke		153	28.02
Cancer		61	11.19
Hypertension		392	71.66
Diabetes		363	66.36
Dementia		188	34.43
Depression		143	26.38
Benign prostatic hyperplasia		80	14.81
Osteoporosis		104	19.37
Fracture		67	12.27
Pressure ulcers		126	23.03
Status	Deceased	199	35.9
	Alive	355	64.1
Mode of feeding	Oral feeding	191	34.9
	Oral with assistance	264	48.2
	Nasogastric tube	61	11.1
	PEG Tube	31	5.7
	Jejunostomy tube	1	0.2

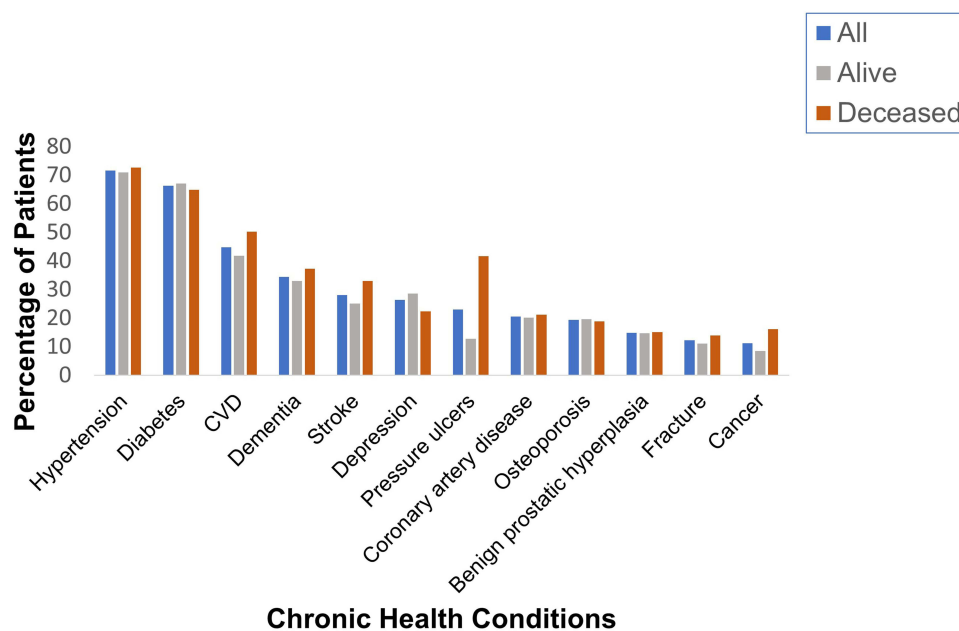


Figure 1 Distribution of chronic health conditions among Saudi people receiving long-term HHC services.

Predictors of Mortality

When testing variables individually, deceased patients were significantly more likely to have been diagnosed with cancer, as well as have had pressure ulcers, relative to those who were alive ($\chi^2 = 7.252$, $p = 0.007$, and $\chi^2 = 59.125$, $p < 0.001$, respectively; [Supplementary Table 1](#) in [Supplementary materials](#)). Deceased patients were also significantly older, had higher clinical frailty scores, multimorbidities, received HHC services for significantly shorter durations, and were hospitalized significantly longer ([Supplementary Table 2](#)). $t = -3.44$, $p < 0.001$, $t = -7.67$, $p < 0.001$, $t = -3.41$, $p < 0.001$, $t = 3.71$, $p < 0.001$, and $t = -3.37$, $p < 0.001$, respectively; see [Supplementary Table 2](#) in [Supplementary Materials](#)). All of these associations remained after correction for multiple comparisons.

To account for the partial overlapping effects of these associations, we used binary logistic regression modeling to predict the probability that patients were indicated as deceased using the variables that were significantly different between the two groups, based on FDR-adjusted p -values. This included the presence of pressure ulcers or cancer of any kind, patient age, clinical frailty score, multimorbidity, the number of days hospitalized, and the overall time spent in-home health care service.

The presence of pressure ulcers and frailty were each significantly associated with an increased risk of patient mortality while controlling for one another and controlling for other variables shown in [Table 2](#). None of the total days

Table 2 Predictors of Mortality of HHC Service Recipient

Predictor	B	S.E.	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)	
						Lower	Upper
Days hospitalized	0.010	0.005	3.384	0.066	1.010	0.999	1.021
Time spent in HHC services	-0.001	0.000	3.509	0.061	0.999	0.999	1.000
Age	0.017	0.018	0.938	0.333	1.017	0.983	1.053
Cancer	0.680	0.436	2.432	0.119	1.974	0.840	4.639
Pressure ulcers	1.341	0.336	15.898	<0.001*	3.824	1.978	7.393
Multimorbidity	-0.728	0.438	2.767	0.096	0.483	0.205	1.139
Clinical frailty score	0.579	0.183	10.022	0.002*	1.784	1.247	2.552

Notes: The significance of predictors of patient status (alive or deceased) as partial effects estimated using logistic regression. Asterisks denote significant associations: * $p < 0.05$.

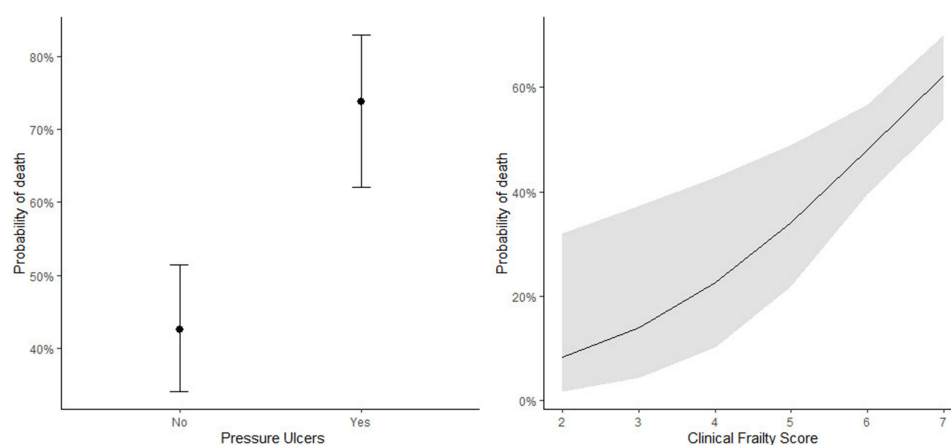


Figure 2 Significant partial associations between mortality and each of clinical frailty score and pressure ulcers.

hospitalized, days in-home health care services, age, cancer, or multimorbidity were significantly associated with patient mortality when modeled alongside one another. The significance of these effects is in Table 2, and associations are depicted in Figure 2. The logistic regression model fit was moderately strong (AUC=0.779, sensitivity=0.758, specificity=0.682).

Discussion

This is the first study in Saudi Arabia to cross-sectionally and retrospectively report the outcomes of a typical home health care program. Our results show that pressure ulcers and the degree of frailty are the strongest predictors of mortality in individuals receiving home care services. This finding is concordant with other studies confirming the importance of pressure ulcers as a predictor of mortality and poor clinical outcomes for individuals receiving home care services.^{17–19}

This study showed that most patients had at least one chronic disease. Hypertension, diabetes, and CVD were the most common chronic disease reported. According to the Saudi Health Interview Survey (SHIS)—A national multistage survey of 10,375 individuals aged 15 years or older—the prevalence of hypertension and diabetes among those aged 65 or older were 65% and 50%, respectively.²⁰ The hypertension prevalence of this study was higher than that of SHIS (71.66% vs 65%) and the diabetes prevalence (66.36 vs 50%).²⁰

Skin failure signifies a state of physiological stress resulting from immobility, poor nutritional status, impaired tissue oxygenation, and mechanical stress.²¹ The occurrence of pressure ulcers can indicate poor quality of care or multisystem failure at the end of life.²¹ Understanding the difference between pressure ulcers in each setting is crucial for care providers to provide the appropriate care plan in each setting and for monitoring bodies to assign the right quality indicators for pressure wounds occurring in different settings.

Our study did not show a significant association between functional decline and poor clinical outcomes. To assess the global functional performance, we used validated measures for assessing the basic and instrumental activities of daily living.^{14,15,22,23} Our results come in contrast with most studies that show a significant association between functional performance and increased risk for mortality.^{18,24,25} One reason could be our cohort's restrictive admission criteria for home health care service, which only permits admission for people with significant mobility and functional impairment. Another reason could be related to the cultural aspect of older individuals living in Saudi Arabia, whereby functional dependence on children or caregivers could be part of the traditional habit rather than the need for actual assistance for activities of daily living.²²

The average readmission rate for our cohort is 2.23 times per year. This high rate of annual readmission carries a significant implication for the individual's clinical care and quality of life. On the other hand, the high readmission rate is a known negative quality performance indicator. It calls for continuous quality improvement projects to understand the possible causes underpinning this high rate and attempt to reduce it. Most of our cohort are functionally impaired, which

further complicates their physical ability to transfer to and from the hospital, increasing their risk of physical injury. Moreover, hospital admission increases the risk for hospital-acquired complications such as delirium, pneumonia, pressure injuries, and further functional decline.^{26,27}

Our study has several strengths. It is the first study to systematically assess the functional performance of individuals receiving home health care services in Saudi Arabia using validated and culturally adapted tools and its association with important clinical outcomes such as mortality and hospital readmission.¹³ Second, our study used rigorous methods to report the prevalence of chronic disease in a representative sample of individuals receiving home health care services compared to previous studies in Saudi Arabia.^{9,28,29} However, our study has several limitations. We reported data from a single center; therefore, caution has to be applied in generalizing the results of our study. Moreover, to study chronic disease prevalence, individuals should be recruited from multiple sites in Saudi Arabia with an adequately representative sample size. Finally, we started using the BADLS and Katz assessment tools in 2020 and 2021. Therefore, we could have underestimated the association between functional measures and clinical outcomes.

Conclusions and Implications

In conclusion, our study found that hypertension and diabetes were the two most common conditions diagnosed in HHC service recipients. On the other hand, pressure ulcers and frailty are the strongest predictors of mortality for individuals receiving home health care services. Moreover, we found a high rate of annual readmission for individuals enrolled in HHC, which requires further analysis to understand the possible contributing factors for the increased rate of hospital readmission and develop strategies to address them. Future studies should focus on designing quality improvement projects to improve the quality of life for individuals receiving HHC services, especially those with pressure ulcers at the end of life.

Abbreviations

HHC, Home Health Care; MOH, Ministry Of Health; HER, Electronic Health Records; BADLS, Bristol Activity of Daily Living Scale; CFS, Clinical Frailty Scale.

Data Sharing Statement

Data are available upon reasonable request to the corresponding author.

Ethics Committee Approval

Human Research Ethics Committee approval was provided by the King Saud University (KSU) Institutional Review Board, reference number 21/0697/IRB project number KSU-IRB 017E, informed consent is waived for retrospective study based on our institutional policies. Data were anonymized before secured storage. This study was performed in compliance with the Declaration of Helsinki.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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