Effect of the Place of Living on Mortality in Patients with Advanced Heart Failure

CURRENT STATUS: UNDER REVIEW

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DOI:
10.21203/rs.2.22957/v1

SUBJECT AREAS
General Practice

KEYWORDS
Advanced heart failure, Rural health, Community healthcare, Health inequalities
Abstract

Background

Social and environmental factors in advanced heart failure (HF) patients may be crucial to cope with the end stages of the disease. This study analyzes health inequalities and mortality according to place of residence (rural vs urban) in HF patients at advanced stages of the disease.

Methods

Population-based cohort study including 1148 adult patients with HF attended in 279 primary care centers. Patients were followed for at least one year after reaching New York Heart Association IV, between 2010 and 2014.

Data came from primary care electronic medical records. Cox regression models were applied to determine the hazard ratios (HR) of mortality.

Results

Mean age was 81.6 (SD 8.9) years, and 62% were women. Patients in rural areas were older, particularly women aged >74 years (p=0.036), and presented lower comorbidity.

Mortality percentages were 59% and 51% among rural and urban patients, respectively (p=0.030). Urban patients living in the most socio-economically deprived neighborhoods presented the highest rate of health service utilization, particularly with primary care nurses (p-trend <0.001). Multivariate analyses confirmed that men (HR 1.60, 95% confidence interval (CI) 1.34-1.90), older patients (HR 1.05, 95% CI 1.04-1.06), Charlson comorbidity index (HR 1.16, 95% CI 1.11-1.22), and residing in rural areas (HR 1.35, 95% CI 1.09 to 1.67) was associated with higher mortality risk.

Conclusions

Living in rural areas determines an increased risk of mortality in patients at final stages of heart failure.
Background

According to data published by the World Bank, the percentage of rural populations fluctuates from 19 to 59% depending on the degree of development of the countries in question. In spite of these figures, however, differences in health and disease patterns between rural and urban areas have not been widely studied.

Evidence concerning inequalities in health and mortality between rural and urban settings, has reported conflicting results with respect to the source and characteristics of the population.

With respect to cardiovascular diseases, coronary heart disease mortality has been observed to be more prevalent in rural areas, and similar results have been published for heart failure (HF) although only regarding men.

Whilst the HF incidence rate has declined in recent years, its prevalence has increased, suggesting that survival over time is longer, probably due to better care and treatment. Nevertheless, this improvement in survival is modest, and research in HF is considered one of the most important priorities. Patients classified as New York Heart Association (NYHA) III/IV present almost four-fold greater rates of mortality, and up to 58.3% of NYHA IV dies after a five-year follow-up. However, due to its irregular evolution, HF is not usually considered a terminal disease, whilst at advanced stages it could be compared to malignant neoplasms.

Although many predictors of mortality among HF patients have been well identified, social and environmental determinants are not usually included in predictive models, particularly in patients at terminal stages of the disease. Some studies have shown worse prognoses regarding socio-economic position, social risk, health literacy and urban
areas of residence \textsuperscript{17}.

Even though gaps in the availability of general palliative care in rural areas have been reported \textsuperscript{18}, information about the differences in the lifetime of HF patients or health services utilization depending on their residence and socio economic level is scarce.

Methods

This study was aimed at analyzing health inequalities and mortality according to place of residence (rural vs urban) in HF patients at advanced stages of the disease (NYHA IV) attended in the community by analyzing real world data.

We followed a population-based cohort of adult patients presenting the most advanced stages of heart failure (NYHA IV) between January 1st, 2010, and December 31st, 2014. The inclusion date was taken to be when patients were first registered as having NYHA IV in their primary healthcare electronic medical records during the study period. NYHA IV was considered when patients diagnosed from HF were unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest \textsuperscript{19}. The whole cohort was followed-up for at least one year from the inclusion date or until a fatal occurrence took place during the study period.

Information was collected from the primary care electronic medical records, through the Information System for the Development of Research in Primary Care (SIDIAP). This database contains data from 5.8 million individuals attended in 279 primary healthcare centers which attend 80\% of the whole population of Catalonia (north-east Spain), and it has already been validated for use in cardiovascular research \textsuperscript{20}.

The database incorporates both administrative and clinical data which are encrypted to guarantee the confidentiality and anonymization of the information gathered for research purposes and provides data about diagnoses, clinical characteristics, comorbidity,
laboratory and diagnostic tests, social and demographic variables, and performance in activities of daily living, tests to evaluate functional physical and mental status, drug prescriptions, and primary health care service utilization. Information regarding the patients’ vital status is also included and comes from the Central Insurance Register (RCA).

Patients with HF were identified using the International Classification of Diseases, Tenth Revision (ICD 10), claim code I50.

The ICD 10 codes selected to register comorbidities were: diabetes (E10-E14), hypertension (I10-I15), coronary heart disease (I20-I25), stroke (I63-I65), atrial fibrillation (I48), chronic kidney disease (N18), chronic lower respiratory diseases (J40-J44), and cancer (C00-C97).

Clinical variables, laboratory analyses, and tests assessing functional were obtained from the patient’s consultation closest to the inclusion date, and missing values were imputed. The Barthel index, which has proved helpful in assessing the functional status of a patient 21, and the Charlson index, used to predict ten-year mortality and healthcare resource utilization in patients with a range of comorbid conditions 22 were regularly collected during the nurses’ consultations.

To determine socio-economic status among the urban patients we employed the MEDEA Index which is an aggregated socioeconomic deprivation model which classify the population living in small geographical areas (census tracts) which is smaller than urban districts, according to the percentage of unemployment, manual and temporary workers, and individuals with insufficient education (less than primary school). The lowest quintile (Urban areas 1) represents individuals with the most favorable socio-economic position, and the upper one the worst (Urban areas 1). The unit of aggregation is the census. This
index has been proven valid for urban areas although in rural ones it does not discriminate accurately (23).

Social and family networks, as well as living conditions, were assessed through an interview by a social workers or nurses.

Health service utilization was computed as the number of consultations made with the family physician, primary care nurse, or specific primary care emergency services.

Rural residence was defined when patients lived in an area with less than 10,000 inhabitants, or the density of population was lower than 150 inhabit/km2, according to the Catalan Healthcare Administration classification.

The prescription of angiotensin converting enzyme inhibitors, angiotensin II receptor blockers, beta blockers, mineral corticoid antagonists, and loop diuretics was also collected.

The primary outcome was all-cause mortality occurring during the follow-up.

Results

Descriptive findings

We analyzed data from 1148 HF patients in NYHA IV. Mean age was 81.6 (SD 8.9), 95% of patients were older than 64 years, and 61% were women. Most of the population lived in urban areas (N=972) and more than 69% were older than 74 years (N=793). Among the total number of patients included, 68% presented high comorbidity according to the Charlson index (score >=3), and daily living activities were moderately to severely affected (Barthel Index < 60) in 56%.

The most frequently associated comorbidities were hypertension (79%), atrial fibrillation (47%), diabetes (42%), and coronary heart disease (34%). Cardiovascular comorbidity (coronary heart disease, atrial fibrillation, and stroke) was present in 69% of the patients, and 22% presented two or more of these conditions.
Regarding the number of chronic conditions included in the analyses, the median was 3 (percentile 25-75, 2-4), and 62% of HF patients had simultaneously three or more comorbidities.

Beta-blockers, angiotensin converting enzyme inhibitors/angiotensin II receptor blockers, and mineral corticoid antagonists were prescribed in 45%, 66%, and 26% of patients, respectively. A combination of the three medications was present in 10%, whilst loop diuretics were prescribed in 88%.

During the period of the study, patients consulted their family physician on average 22 occasions, 20 with their primary care nurse, and on three occasions the primary healthcare emergency centers.

**Differences between urban and rural patients**

Mean follow-up until the end of the study, or the occurrence of a fatal event, was 16 months (SD 12.4) for urban and 14.5 months (SD 10.9) for rural patients, respectively.

Although rural patients were, on average, two years older, they presented lower comorbidity (Charlson index). In spite of not being statistically significant, the urban cohort tended to live more commonly alone.

No differences in cardiovascular comorbidity, clinical variables, performance in activities of daily living, or HF medication were reported between rural and urban patients.

Table 1 describes how in analyses stratified by gender there were no outstanding differences regarding place of residence in any of the variables, with the exception of age (older women in rural areas) and the higher percentage of women living alone in the cities.

We compared primary healthcare service utilization by HF patients, according to place of residence and socioeconomic deprivation it was observed that those in the most socio-economically deprived urban areas tended to use more frequently primary care emergency
services than the other urban individuals, and even three more times compared to rural ones. Regarding consultations with the family physician and primary healthcare nurses, patients in the most deprived urban areas were the greatest users of the former and this higher utilization was statistically significant in the case of the later. (Figure 1)

**Overall mortality**

Among the 592 patients (52%) who died during the period of the study, 488 (82%) lived in urban and 104 (18%) in rural areas, respectively. Analyzing the number of fatal events during follow-up, the mean rate of survival from study inclusion was 10.6 (SD 9.9) and 9.8 (SD 9.8) months, for the urban and rural cohorts, respectively.

Older age, Charlson comorbidity index, chronic kidney disease, higher potassium levels, cancer, were related with a higher risk of dying.

In contrast, greater body mass index, blood pressure, glomerular filtration, Barthel index, and hemoglobin were protective with respect to mortality risk (Table 2). When analyzing sociodemographic variables related to mortality we found that being men, older, living in rural areas and having unfavorable housing conditions (structural barriers and lack of facilities) were related to higher probability of dying, but no significant differences were found among urban patients regarding the area where they lived.

**Multivariate analyses**

Cox multivariate regression model, adjusted by the variables significantly associated both with the mortality and the place of living, confirmed that being men, older, having higher comorbidity, and living in rural areas were associated with higher risk of mortality. (Figure 2). The excess of mortality risk for men was 60% whilst for patients living in rural areas it was 35% (HR 1.35, 95% CI 1.09 to 1.67).

**Discussion**

In our study, based on a community cohort of HF patients at the most advanced stages of
the disease, we observed that mortality was 35% higher in those residing in rural setting. Being men, aged, and presenting higher comorbidity were also found to be related to a greater risk of dying. We found an inverse gradient in primary healthcare resources utilization regarding socio-economic deprivation among urban patients, those residing in the most deprived socio-economic areas had the highest health services utilization. Compared to the rest of Europe, the population density in the study region is among one of the highest, the distribution is, however, irregular with more than 40% of the inhabitants concentrated in the metropolitan area of Barcelona. Although a number of small hospitals are distributed across the territory, most tertiary hospitals are located in this large metropolitan area which can limit accessibility of rural patients to highly specialized care.

With respect to place of residence, we did not observe differences in clinical characteristics or HF medication prescribed. Although rural women were slightly older, urban patients presented higher comorbidity and reported more social isolation. This last finding concurs with a previous study reporting that in a rural environment it is easier to rely on family members.\textsuperscript{24}

We found a considerable number of consultations, particularly with primary care nurses, among the urban patients living in the most deprived areas. In this regard, it has already been reported that low income and other psycho-social disadvantages imply greater healthcare resource utilization.\textsuperscript{25} Material need insecurities has been described to be related to higher health services utilization in USA, in patients with chronic conditions, particularly marked in emergency departments, as a consequence of bad control of their disease, probably due to food insecurity and cost-related medication underuse.\textsuperscript{26}

\textbf{Mortality}
The higher mortality described for men, older HF patients, and in those with decreased body mass index, chronic kidney disease, and lower blood pressure levels, concurs with previous studies, particularly in the advanced stages of the disease. Moreover, higher mortality in rural patients is in agreement with a previous study. It has been hypothesized that populations residing in urban areas have better health due to easier accessibility to health services, in addition to better jobs and income.

Regarding cardiovascular diseases, inequalities in rural patients have been reported with respect to access to treatment, such as percutaneous coronary interventions, which require a longer travelling distance.

Another possible factor contributing higher mortality among rural HF patients in our sample could be the differences reported in the use of health services. The benefits of telemedicine conducted by specialized nurses in the management of HF have also been published. It is reasonable to consider that this kind of programs may be effective in providing better care to patients living in isolated areas. Nevertheless, a recent systematic review did not describe a clear effect on mortality derived from such interventions in rural areas. In our region, for the present, the impact of these programs has only been reported for urban areas.

The healthcare administration has developed primary care case-management programs to provide HF patients with better attention through continued assistance from nurses. Most consultations are at the patients’ own homes, the nurses coordinating with the general practitioners and specialists from the reference hospitals. Implementation of this program, however, is still irregularly distributed across our territory.

There is also a widespread network of primary healthcare out-of-hours centers, nevertheless, its distribution and characteristics vary. The centers are more complete in
large cities, whilst in the rural areas more complex assistance needs to be provided in small hospitals.

Many rural patients lack daily access to their family doctors which can lead to delay in the treatment of decompensations. Other factors might be involved in explaining in these differences. The decision to die at home allows patients to maintain control over their lives. The approach to the end of life is culturally different in a rural setting compared to an urban one. For instance, rural patients could be more in favor of dying at home and not prolonging their lives through hospitalizations and aggressive interventions. Mean survival time among patients who died in our study was slightly higher among the urban ones. Nevertheless, considering the considerable limitations such patients undergo in their daily activities, it may be questioned whether this increased survival time is cost effective in terms of quality of life.

Evidence regarding socioeconomic deprivation among urban residents is controversial. Hawkins et al., employing a geographical composite deprivation index similar to ours, and analyzing data from 2000 to 2007, did not describe differences regarding outcomes in HF patients. In a more recent article, Witte et al., using the same deprivation index as Hawkins, reported that socioeconomic deprivation was linked to an increased risk of death in HF patients, but only as a consequence of non-cardiovascular causes. In addition, a study performed with the same population in our country showed a protective, although not significant, effect regarding mortality in the most deprived urban patients.

The National Health Service in our country provides universal healthcare, which may reduce social inequalities in health by facilitating access to primary care, prescriptions and hospitals to populations lacking economic resources, but the distribution of healthcare premises in rural and remote areas is conditioned by geographical limitations.
Nevertheless, future research will be needed to explain why, with no differences in either cardiovascular comorbidities or treatment, rural HF patients had the highest mortality rates.

**Strengths and Limitations**

Although different approaches have been employed to define rurality, our definitions concur with others used in similar articles. Nevertheless, due to data limitations, we could not fully discriminate the analyses between patients living in the most isolated areas from the other rural ones to ascertain whether differences in accessibility related to mortality are proportional to distance and frequency of healthcare service provision. The deprivation index used to study urban socioeconomic differences assumes homogeneity among the population living in the same geographical area, but may imply an ecological fallacy because it is possible to find both poor and affluent individuals in the same areas, sometimes divided by only one street. Moreover, we lack information in order to discriminate the presence of socio-economic differences within rural populations and thus considered them homogeneous in terms of social status.

Since administrative databases are used for clinical purposes can lead to missing data. In the case of HF some variables such as ejection fraction are not always available to have proper diagnoses according to guidelines\(^36\). Nevertheless in our study this fact is not relevant because all patients were at final stages of the disease. Regarding other possible missing values we performed multiple imputation models to minimize such an effect.

It would be advantageous to possess data regarding quality of life in order to analyze differences among rural and urban patients.

Further research has to be made to explore possible explanations to the differences between rural and urban patients, beyond the accessibility to health care services, such as patient’s beliefs and preferences regarding the treatment received at the end of life.
This article is that it is the first to specifically analyze real world evidences from elderly HF patients at advanced stages of the disease through a large database.

Conclusions

Mortality in elderly patients with heart failure at the final stage of HF is higher among those living in rural setting. Accessibility and inequalities in the healthcare provided with respect to the place of residence may contribute to such differences. The increased healthcare services utilization by urban patients living in most socioeconomic deprived areas is not followed by a reduction in mortality.

Health policies should face with social and geographical inequalities, to ensure that most part of population have similar access to healthcare provision, especially to primary care services, which are essential in improving health and reducing mortality.

Abbreviations

HF: Heart failure; NYHA: New York Heart Association; HR: Hazard ratios; CI: Confidence interval; RCA: Central Insurance Register; SIDIAP Information System for the Development of Research in Primary Care.

Declarations

Acknowledgements

We thank to the Information System for the Development of Research in Primary Care (SIDIAP) professionals their support with data collection.

Authors’ contributions

MAM, RG, JLV, EN, JD, and JMVR participated in the interpretation of results, the elaboration and revision of the drafts of the manuscript and in the approval of the final version. EN participated in the data management, analysis and elaboration of the last draft and the approval of the final version. All the authors gave final approval of the
version to be published.

**Funding**

This study has been granted by the Primary Healthcare University Research Institute IDIAP-Jordi Gol.

**Availability of data and materials**

The datasets generated and/or analysed during the current study are not publicly available due to the restrictions by the data owner (IDIAP Research Institute), but could be available from the corresponding author on reasonable request.

**Ethics approval and consent to participate**

The study protocol was approved by the Primary Healthcare University Research Institute IDIAP- Jordi Gol ethics committee (reference number: P13/052). Confidentiality of data was guaranteed in all the process of the study, and data available for research purpose was anonymous. Since the data obtained underwent a double process of anonymization, no interventions were made and the research team had not access to the patient information, ethics committee considered not necessary the patient informed consent. To obtain the access to the database an external scientific committee from IDIAP Jordi Gol assessed and approved the quality and appropriateness of the study protocol, before its submission to the ethics committee. We had permission from our Research Institute (IDIAP Jordi Gol) to accede to the database and publish this manuscript.

**Consent for publication**

Not applicable

**Competing interests**

The authors declare that they have no competing interests.

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Tables

Table 1: Characteristics of patients with heart failure at New York Heart Association IV according to their place of residence

|                | Overall |         | P value | Women |         | P value |
|----------------|---------|---------|---------|-------|---------|---------|
|                | Urban N = 972 | Rural N = 176 |         | Urban N = 598 | Rural N = 110 |         |
| N (%)          | N (%)   |         |         | N (%) | N (%)   |         |
| Age <65 years  | 48 (5)  | 7 (4)   | 0.036   | 20 (3) | 2 (2)   | 0.027   |
| Age 65-74 years| 131 (14)| 12 (7)  |         | 66 (11) | 4 (4)   |         |
| Age >74 years  | 793 (82)| 157 (89)|         | 512 (86) | 104 (95)|         |
| Mortality      | 488 (51)| 104 (59)| 0.037   | 277 (46) | 60 (54) | 0.120   |
| Cardiovascular risk and comorbidity |         |         |         |       |         |         |
| Body Mass Index a | 30.4 (6.8) | 29.4 (5.8) | 0.112 | 31.6 (7.1) | 30.5 (6.3) | 0.186 |
| Smoker         | 36 (4)  | 5 (3)   | 0.404   | 8 (1)   | 0 (0)   | 0.490   |
| Diabetes       | 422 (23)| 63 (36) | 0.062   | 248 (42)| 38 (35) | 0.210   |
| Coronary heart disease | 326 (34) | 49 (28)  | 0.163 | 162 (27) | 22 (20) | 0.150   |
| Stroke         | 141 (15)| 22 (13) | 0.465   | 79 (13) | 12 (11) | 0.612   |
| Chronic kidney disease | 331 (34) | 60 (34)  | 0.999 | 217 (36) | 36 (33) | 0.543   |
| Chronic Obstructive Pulmonary disease | 322 (33) | 56 (32) | 0.738 | 121 (20) | 24 (22) | 0.803 |
|--------------------------------------|----------|---------|--------|----------|---------|--------|
| Atrial fibrillation                  | 453 (47) | 83 (48) | 0.897  | 305 (51) | 51 (56) | 0.429  |
| Cancer                               | 183 (19) | 33 (19) | 0.989  | 96 (16)  | 18 (16) | 1.000  |
| Hypertension                         | 774 (80) | 135 (77)| 0.384  | 500 (83) | 94 (86) | 0.732  |

Clinical variables

| Heart rate (beats/minute)<sup>a</sup> | 76.9 (14.4) | 76.0 (15.8) | 0.456 | 76.8 (14.6) | 75.5 (16.4) | 0.450 |
|--------------------------------------|-------------|-------------|--------|-------------|-------------|--------|
| Systolic blood Pressure (mmHg)<sup>a</sup> | 126.0 (18.6) | 124.0 (18.4) | 0.208 | 127.0 (19.0) | 125.0 (18.1) | 0.222 |
| Diastolic blood pressure (mmHg)<sup>a</sup> | 68.2 (10.6) | 67.1 (10.6) | 0.192 | 68.9 (11.0) | 67.8 (9.8) | 0.297 |
| Potassium<sup>a</sup>                | 4.6 (0.6)   | 4.5 (0.5)   | 0.780 | 4.5 (0.5)   | 4.5 (0.5)   | 0.711  |
| Sodium<sup>a</sup>                   | 141.0 (3.7) | 140.0 (3.9) | 0.485 | 141.0 (3.6) | 141.0 (3.8) | 0.713  |
| Glomerular filtration<sup>a</sup>    | 46.7 (14.6) | 46.6 (13.8) | 0.894 | 44.7 (13.8) | 44.3 (13.5) | 0.796  |
| Hemoglobin<sup>a</sup>               | 12.1 (1.8)  | 12.1 (1.7)  | 0.993 | 11.9 (1.6)  | 12.1 (1.6)  | 0.268  |
| Charlson index<sup>a</sup>           | 3.6 (1.8)   | 3.3 (1.5)   | 0.031 | 3.4 (1.7)   | 3.1 (1.4)   | 0.058  |
| Barthel index<sup>a</sup>            | 57.3 (27.9) | 55.9 (31.1) | 0.535 | 52.5 (27.3) | 51.4 (29.6) | 0.707  |

Medication

| Beta- blockers                      | 448 (46)   | 69 (39)    | 0.098 | 274 (47)   | 46 (42)    | 0.406  |
| ACEi or ARB<sup>b</sup>             | 639 (42)   | 119 (49)   | 0.692 | 400 (67)   | 78 (71)    | 0.474  |
| MRA<sup>c</sup>                     | 263 (27)   | 41 (23)    | 0.343 | 143 (24)   | 19 (17)    | 0.161  |
| Loop diuretics                      | 859 (88)   | 156 (89)   | 0.929 | 522 (87)   | 99 (90)    | 0.524  |

Social variables

| Living alone                        | 301 (31)   | 42 (24)    | 0.071 | 195 (33)   | 26 (24)    | 0.079  |
| Inadequate housing conditions       | 424 (44)   | 83 (47)    | 0.384 | 243 (419)  | 54 (49)    | 0.122  |

<sup>a</sup>Mean (Standard deviation); <sup>b</sup>ACEi: angiotensin converting enzyme inhibitors, ARB: Angiotensin II receptor blockers;<sup>c</sup>MRA: mineralocorticoid receptor antagonists.

Table 2: Clinical variables related to the global mortality of patients with heart failure at New York Heart Association IV

|                          | All N = 1148 | Alive N = 556 | Dea N = 5 |
|--------------------------|--------------|---------------|-----------|
|                          | N (%)        | N (%)         | N (%)     |
| Men                      | 440 (39)     | 185 (34)      | 255 (37)  |
| Age<sup>a</sup>          | 81.6 (8.9)   | 79.7 (9.3)    | 83.3 (1)  |
| Cardiovascular risk and comorbidity |              |               |           |
| Condition                                | Mean (SD) 1 | Mean (SD) 2 | Mean (SD) 3 |
|------------------------------------------|-------------|-------------|-------------|
| Body Mass Index                          | 30.2 (6.7)  | 31.5 (6.7)  | 28.9 (1)    |
| Smoker                                   | 41 (4)      | 22 (4)      | 19 (1)      |
| Diabetes                                 | 485 (42)    | 234 (42)    | 251 (1)     |
| Coronary heart disease                   | 375 (3)     | 178 (32)    | 197 (1)     |
| Stroke                                   | 163 (14)    | 78 (14)     | 85 (1)      |
| Chronic kidney disease                   | 391 (34)    | 162 (29)    | 229 (1)     |
| Chronic obstructive pulmonary disease    | 378 (33)    | 170 (31)    | 208 (1)     |
| Atrial fibrillation                      | 536 (47)    | 254 (46)    | 282 (1)     |
| Cancer                                   | 216 (19)    | 81 (15)     | 135 (1)     |
| Hypertension                             | 909 (79)    | 449 (81)    | 460 (1)     |
| Clinical variables                       |             |             |             |
| Heart rate (beats/minute)                | 76.8 (14.6) | 76.6 (15.2) | 76.8 (1)    |
| Systolic blood pressure (mmHg)           | 125.4 (18.6)| 127.7 (18.4)| 123.3 (1)   |
| Diastolic blood pressure (mmHg)          | 68.1 (10.6) | 69.5 (10.7) | 66.7 (1)    |
| Potassium                                | 4.5 (0.6)   | 4.5 (0.5)   | 4.6 (1)     |
| Sodium                                   | 140.6 (3.7) | 140.8 (3.5) | 140.5 (1)   |
| Glomerular filtration                    | 46.7 (14.5) | 48.8 (13.6) | 44.6 (1)    |
| Hemoglobin                               | 12.1 (1.8)  | 12.3 (1.7)  | 11.9 (1)    |
| Charlson index                           | 3.6 (1.7)   | 3.2 (1.6)   | 3.8 (1)     |
| Barthel index                            | 57.1 (28.4) | 59.8 (27.8) | 54.4 (1)    |
| Medication                               |             |             |             |
| Beta-blockers                            | 517 (45)    | 448 (46)    | 69 (1)      |
| ACEi or ARB                              | 758 (66)    | 639 (42)    | 119 (1)     |
| MRA                                      | 304 (26)    | 263 (27)    | 41 (1)      |
| Loop diuretics                           | 1015 (88)   | 859 (88)    | 156 (1)     |
| Social variables                         |             |             |             |
| Living alone                             | 343 (30)    | 164 (29)    | 179 (1)     |
| Inadequate housing conditions            | 507 (44)    | 220 (40)    | 287 (1)     |
| Area of residence (Urban patients)       |             |             |             |
| Urban 1 (less economically deprived)     | 176 (15)    | 82 (18)     | 94 (1)      |
| Urban 2                                  | 166 (14)    | 74 (16)     | 92 (1)      |
| Urban 3                                  | 187 (16)    | 92 (20)     | 95 (1)      |
| Urban 4                                  | 177 (15)    | 93 (20)     | 84 (1)      |
| Urban 5 (most economically deprived)     | 213 (19)    | 116 (25)    | 97 (1)      |
Mean (Standard deviation); \textsuperscript{b} ACEi: angiotensin converting enzyme inhibitors, ARB: Angiotensin II receptor blockers; \textsuperscript{c} MRA: mineralocorticoid receptor antagonists.

**Figures**

**Figure 1**
Primary healthcare services utilization by urban patients with heart failure at New York heart Association (NYHA) IV according to the place of residence (U 1: urban less socioeconomically deprived area to U 5: urban most socioeconomically deprived area)
Figure 2

Hazard ratio and 95% confidence interval for variables predicting mortality adjusted by sex, age, Charlson comorbidity index and place of living.