American Heart Journal Plus: Cardiology Research and Practice 36 (2023) 100340

Contents lists available at ScienceDirect

American Heart Journal Plus: Cardiology Research and Practice

journal homepage: www.sciencedirect.com/journal/american-heart-journal-plus-cardiology-research-and-practice

Research Paper

Relationship of health-related social needs and hospital readmissions in patients following a hospitalization for atrial fibrillation

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ARTICLE INFO

Keywords:
Atrial fibrillation
Social determinants of health
Readmission
Sex differences

ABSTRACT

Atrial fibrillation (AF) has a high economic burden on the healthcare system with rehospitalizations as the most significant contributing factor necessitating an understanding of aspects related to hospitalizations to minimize economic costs and improve patient outcomes. Our study aims to assess whether all-cause 30-day hospital readmission following AF-specific hospitalization is associated with health-related social needs (HRSN) using the Nationwide Readmissions Database (NRD). All hospitalization data were abstracted from the 2015–2019 NRD, including hospitalizations for patients at least 18 years of age with a primary discharge diagnosis of AF. For each hospitalization, we identified secondary diagnoses for five HRSN domains including employment, family, housing, psychosocial, and socioeconomic status. Primary outcomes included all-cause 30-day readmission rates. Secondary outcomes included all-cause 90-day readmissions and diagnosis on readmissions. An estimated 1,807,460 index hospitalizations in the United States included a primary discharge diagnosis of AF. Of these, 97.3 % included a diagnosis in only one HRSN domain with the most frequently diagnosed HRSN domain being housing (54.5 %) followed by socioeconomic (29.4 %), family (10.0 %), employment (6.1 %), and psychosocial (2.8 %). Index hospitalizations that included any HRSN diagnosis had 2.2-times greater unadjusted odds of all-cause 30-day readmission (95 % CI: 2.1 to 2.3-times greater, $p < .001$). Index hospitalizations that included an HRSN diagnosis were associated with higher rates of 90-day readmission due to conduction disorder and COPD. In conclusion, there is a significant association between HRSN and hospital readmissions in patients with AF. Further research is required to explain the true nature of this relationship with a specific emphasis on housing insecurity.

1. Introduction

Atrial fibrillation (AF) is the most common cardiac arrhythmia affecting about 0.5 % of the population worldwide and its increasing prevalence is projected to become a public health challenge within the next 30 years [1]. Moreover, AF has a high economic burden on the healthcare system with rehospitalizations as the most significant contributing factor [2,3]. Consequently, this necessitates an understanding of aspects related to hospitalizations to minimize economic costs and improve patient outcomes. Recent research has found that social determinants of health play a significant role in the disease course and management of AF [4].

The World Health Organization defines social determinants of health (SDOH) as “conditions in which people are born, grow, live, work, and age” and the broader influences that shape these factors on a systemic level [5]. These include, but are not limited to, race and ethnicity, socioeconomic status, access to healthcare, and health literacy. SDOH are major contributors to health inequities, risks, and outcomes, and due to their direct impact on health, there has been considerable interest in developing a method to systematically organize and standardize

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https://doi.org/10.1016/j.ahjo.2023.100340
Received 12 July 2023; Received in revised form 20 October 2023; Accepted 22 October 2023
Available online 1 November 2023

information about social situations during health encounters [6]. The tenth edition of the International Classification of Diseases (ICD-10) includes a set of diagnosis codes specific to health-related social needs (HRSN) that allow the identification of SDOH. These HRSN codes have the potential to serve as an indicator of the impact of SDOH on outcomes such as hospital readmissions and have been promoted by the American Medical Association (AMA) and United Healthcare [7–9].

Multiple studies have assessed the effects of race and ethnicity [10,11], household income [12,13], health literacy [14], rurality [15], and access to ambulatory care [16] on AF prognosis. To our knowledge, no study has assessed the likelihood of readmission given concomitant social needs related to adverse health outcomes. Thus, our study aims to assess whether all-cause 30-day hospital readmission following AF-specific hospitalization is associated with HRSN using a large, nationally representative hospital readmissions database.

2. Methods

2.1. Data source

All hospitalization data were abstracted from the 2015Q4 through 2019 Nationwide Readmissions Database (NRD), which is part of a family of databases within the Healthcare Cost and Utilization Project (HCUP) developed through a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ) [17]. The NRD allows estimation of nationally representative hospital readmissions for all ages. Unweighted, the NRD contains data from approximately 18 million discharges each year, and when weighted, it estimates roughly 35 million discharges [17]. Because the NRD does not contain any identifying personal information, our study was determined to not involve human subjects under 45 CFR 46.102(f) and thus was exempted from Institutional Review Board (IRB) approval.

2.2. Hospitalization cohort

We identified hospitalizations for which the patient was at least 18 years of age and had a primary discharge diagnosis of AF (ICD-10-CM: I48.0, I48.1×, I48.2×, I48.91). For each hospitalization meeting those inclusion criteria, we identified secondary diagnoses for five HRSN domains that included employment (ICD-10-CM: Z56.xx, Z57.xx), family (ICD-10-CM: Z62.xxx, Z63.xx), housing (ICD-10-CM: Z59.0×-Z59.3), psychosocial (ICD-10-CM: Z64.x, Z65.x), and/or socioeconomic status (ICD-10-CM: Z55.x, Z59.4.xx-Z59.9, Z60.x).

2.3. Outcomes

Our primary outcomes included all-cause 30-day readmission rates. Secondary outcomes included all-cause 90-day readmissions and diagnosis on readmission as indicated by Medicare Severity-Diagnosis Related Groups (MS-DRG). In addition, outcomes at the index hospitalization were assessed for in-hospital mortality, length of stay, and hospital cost. Hospital cost was inflation-adjusted to 2019 US dollars [18].

2.4. Covariates

For each hospitalization, we abstracted patient demographic characteristics that included age, biological sex, primary payer, income quartile, whether the admission occurred on a weekend, and whether the admission was elective. We also abstracted patient clinical characteristics that included whether the patient underwent AF ablation (ICD-10-PCS: 02583ZZ) and/or cardioversion (ICD-10-PCS: 5A2204Z) during the index hospitalization, whether the patient had a documented history of pacemaker placement, CABG, ICD, and/or PCI (ICD-10-CM: Z95.0, Z95.1, Z95.810, and Z98.61 respectively), as well as the 29 Elixhauser comorbidities which were subsequently used to calculate separate Elixhauser comorbidity indices for in-hospital mortality and all-cause readmission [19,20]. Finally, we abstracted facility demographic characteristics that included bed size and location-teaching status.

2.5. Statistical analysis

All descriptive statistics are stratified by the presence of at least one HRSN diagnosis. Continuous variables are presented as median and interquartile range and were compared between HRSN status using linear regression. Categorical variables are presented as percent and were compared between HRSN status using the chi-square test; no descriptive statistics or statistical analyses are presented for any result based on 10 or fewer observed hospitalizations per the NRD Data Use Agreement (indicated by an asterisk) [21]. Unadjusted logistic regression models were estimated to evaluate whether all-cause readmission was associated with HRSN; separate models were estimated including an overall HRSN indicator or including the five individual HRSN domains. Adjusted logistic models included age, biological sex, primary payer, income quartile, weekend admission, elective admission, length of stay at index hospitalization, Elixhauser comorbidity index for readmission, as well as facility bed size and location-teaching status. We also evaluated the interaction of HRSN with biological sex to assess whether between-HRSN differences in odds of readmission differed between males and females. Finally, an unadjusted logistic regression model was estimated for in-hospital mortality and cause-specific readmissions, whereas unadjusted log-normal regression models were estimated for length of stay and hospital cost. All analyses were conducted using SAS v. 9.4 and accounted for the NRD sampling design with national-level results estimated using the appropriate sampling weight.

3. Results

From the 2015Q4 through 2019 NRD, an estimated 1,807,460 index hospitalizations in the United States included a primary discharge diagnosis of AF (unweighted: 974,563 hospitalizations), of which 16,879 (0.9 %; unweighted: 9706 hospitalizations) included an HRSN domain as a secondary diagnosis. Of the hospitalizations that included an HRSN diagnosis, 97.3 % included a diagnosis in only one HRSN domain with the most frequently diagnosed HRSN domain being housing (54.5 %) followed by socioeconomic (29.4 %), family (10.0 %), employment (6.1 %), and psychosocial (2.8 %). As shown in Table 1, index hospitalizations with an HRSN diagnosis included patients that were younger, higher prevalence of male sex, lower income quartiles, as well as a higher rate of non-elective and weekend admissions, lower rates of AF ablation, and greater comorbidity burden (specifically, alcohol abuse: 31.8 % vs. 4.9 %, electrolyte disorder: 31.8 % vs. 23.9 %, chronic lung disease: 33.8 % vs. 24.6 %, and psychoses: 10.2 % vs. 1.8 %).

3.1. All-cause readmissions

The overall 30-day all-cause readmission rate was 14.7 % (95 % CI: 14.6 % to 14.8 %), of which 91.5 % were unplanned. Index hospitalizations that included any HRSN diagnosis had 2.2-times greater unadjusted odds of all-cause 30-day readmission (95 % CI: 2.1 to 2.3-times greater, $p < .001$; 27.4 % vs. 14.6 %; Fig. 1). In the presence of an HRSN diagnosis, 30-day readmission rates were highest when the HRSN domain was due to housing followed by psychosocial, socioeconomic, employment, and family (Fig. 2).

After adjusting for demographic and clinical characteristics, hospitalizations that included an HRSN diagnosis had 73.8 % higher adjusted odds of all-cause 30-day readmission (95 % CI: 64.1 % to 83.9 % greater, $p < .001$; Table 2). A similar result was observed when evaluating only unplanned readmission (adjusted odds ratio [aOR]: 1.81, 95 % CI: 1.71–1.92, $p < .001$). Furthermore, higher adjusted odds of all-cause 30-day readmission were also observed following hospitalizations in which

Table 1
Demographic and clinical characteristics stratified by HRSN diagnosis.

	HRSN: No	HRSN: Yes	*p*
Age	72 [63, 80]	62 [55, 73]	<0.001
18–34	1.1	1.1	
35–44	2.4	3.8	
45–54	7.2	16.7	
55–64	17.9	33.4	<0.001
56–74	27.9	21.5	
75–84	27.4	13.8	
85+	16.2	9.8	
Biological Sex			
Male	48.8	68.1	<0.001
Female	51.2	31.9	
Insurance			
Medicare	70.9	50.1	
Medicaid	5.4	28.2	
Private	19.4	8.0	<0.001
Self-pay	2.1	8.3	
Other	2.3	5.4	
Income Quartile			
I	27.4	42.5	
II	27.9	24.5	<0.001
III	25.3	19.3	
IV	19.4	13.7	
Bed Size			
Small	17.8	17.2	
Medium	28.9	28.6	0.631
Large	53.3	54.2	
Location-Teaching Status			
Metropolitan Non-Teaching	24.5	23.8	
Metropolitan Teaching	64.7	68.9	<0.001
Non-Metropolitan	10.8	7.3	
Weekend Admission	19.9	24.9	<0.001
Elective Admission	15.1	4.0	<0.001
AF Ablation at Index Hospitalization	4.4	1.4	<0.001
Cardioversion at Index Hospitalization	18.4	9.3	<0.001
History of PCI	1.1	0.7	0.001
History of CABG	7.1	4.1	<0.001
History of Pacemaker	5.6	3.4	<0.001
History of ICD	3.0	2.6	0.025
Elixhauser Comorbidity Index			
In-Hospital Mortality	0 [−2, 8]	1 [−3, 9]	0.028
All-Cause Readmission	8 [0,20]	16 [7, 27]	<0.001

Note. Data presented as median [IQR] or percent.

patients were older, female, or had higher comorbidity burdens, nonelective index hospitalization, longer index hospitalization stay, and Medicaid as primary payer (Table 2). When evaluating diagnosis in an individual HRSN domain, the adjusted odds of an all-cause 30-day readmission was statistically associated with the housing domain (aOR: 2.4, 95 % CI: 2.2–2.6, $p < .001$), but not statistically associated with the employment (aOR: 1.1, 95 % CI: 0.9–1.5, $p = .391$), family (aOR: 1.0, 95 % CI: 0.8–1.2, $p = .667$), psychosocial (aOR: 1.1, 95 % CI: 0.7–1.7, $p = .626$), or socioeconomic (aOR: 1.0, 95 % CI: 0.9–1.2, $p = .455$) domains.

3.2. Biological sex differences in all-cause readmissions

A statistically significant interaction effect was observed between presence of an HRSN domain and biological sex (interaction $p < .001$; Table 3). Specifically for males, presence of any HRSN was associated with 2.0-times higher odds of all-cause 30-day readmission (95 % CI: 1.9 to 2.2-times higher, $p < .001$), whereas in females, presence of any HRSN was associated with 1.2-times higher odds of all-cause 30-day readmission (95 % CI: 1.1 to 1.3-times higher, $p < .001$; Table 3).

The HRSN by biological sex interaction effect was also statistically significant when considering diagnoses within an individual HRSN domain (omnibus interaction $p = .038$), which was driven primarily by HRSN due to housing (housing-by-sex interaction $p = .010$; Table 3). Specifically for males, presence of housing HRSN was associated with 2.5-times higher odds of all-cause 30-day readmission (95 % CI: 2.3 to 2.7-times higher, $p < .001$), whereas in females, presence of an HRSN was associated with 1.9-times higher odds of all-cause 30-day readmission (95 % CI: 1.6 to 2.3-times higher, $p < .001$; Table 3). No other HRSN domain interacted with biological sex indicating that the association between all-cause 30-day readmission and HRSN due to employment, family, psychosocial, or socioeconomic domains were statistically similar for males and females.

3.3. Secondary outcomes

The primary reasons for 30-day readmission defined by MS-DRG are shown in Table 4. Index hospitalizations that included an HRSN diagnosis were associated with higher rates of 30-day readmission due to conduction disorder and COPD, and lower rates of 30-day readmission due to intracardiac procedure, pacemaker, cardiac catheterization, gastrointestinal hemorrhage, and pneumonia. All outcomes reported for 90-day readmissions were similar to those already reported for 30-day readmissions (see supplemental materials). Finally, at index hospitalization, a diagnosis in any HRSN domain was associated with 33.9 %

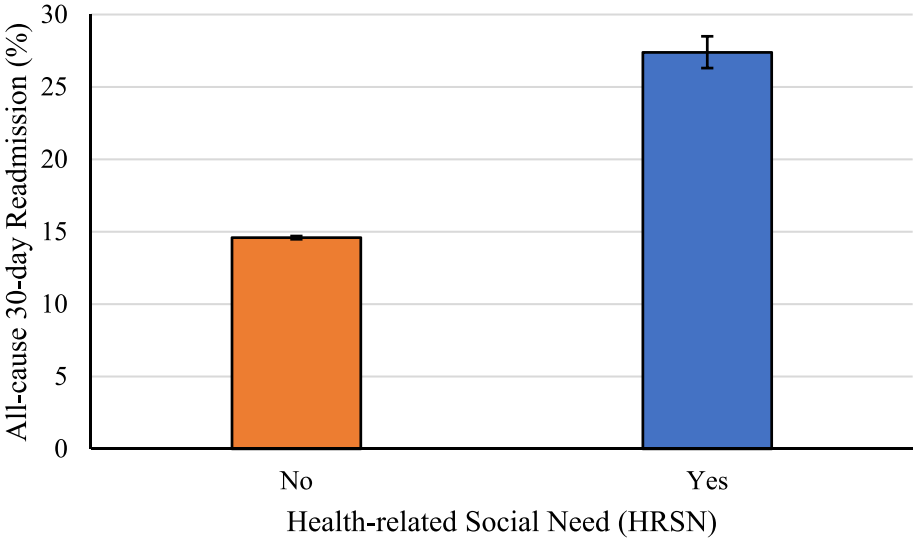

Fig. 1. Unadjusted all-cause 30-day readmission rates for hospitalizations in which the patient did or did not have a secondary HRSN diagnosis. Error bars represent 95 % confidence intervals.

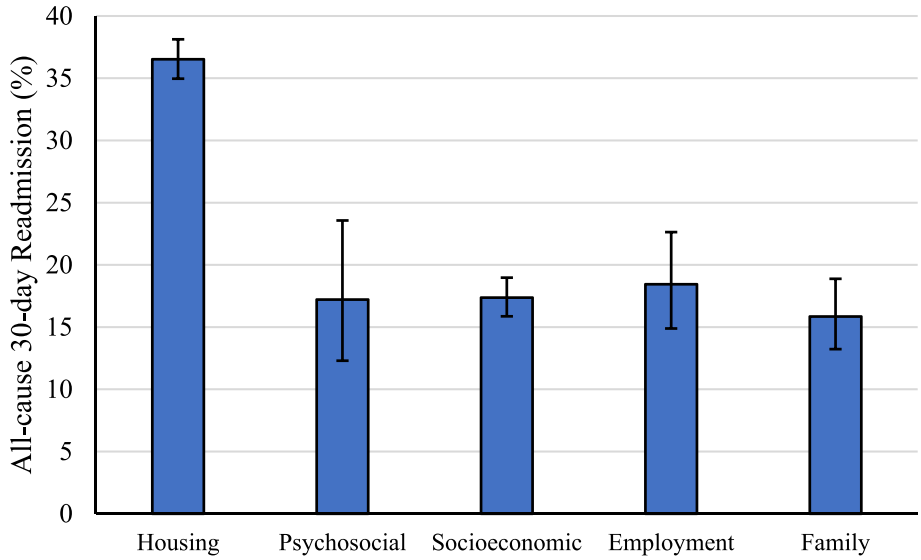

Fig. 2. Unadjusted all-cause 30-day readmission rates by HRSN domain for hospitalizations in which the patient had an HRSN diagnosis. Error bars represent 95 % confidence intervals.

Table 2
Adjusted model results for all-cause 30-day readmissions.

	aOR (95 % CI)	*p*
Health-Related Social Need	1.74 (1.64–1.84)	<0.001
Age (per 10 years older)	1.05 (1.04–1.05)	<0.001
Biological Sex		
Female	1.08 (1.06–1.09)	<0.001
Male	Reference	
Insurance		
Medicare	1.18 (1.13–1.24)	<0.001
Medicaid	1.44 (1.37–1.53)	<0.001
Private	0.82 (0.78–0.86)	<0.001
Self-pay	1.01 (0.94–1.09)	0.776
Other	Reference	
Income Quartile		
I	1.15 (1.12–1.18)	<0.001
II	1.09 (1.06–1.11)	<0.001
III	1.03 (1.01–1.05)	0.013
IV	Reference	
Location-Teaching Status		
Metropolitan Non-Teaching	1.01 (0.99–1.05)	0.342
Metropolitan Teaching	1.00 (0.97–1.03)	0.907
Non-Metropolitan	Reference	
Index Hospitalization		
Weekend Admission	1.03 (1.01–1.04)	0.003
Elective Admission	0.69 (0.67–0.71)	<0.001
Length of Stay	1.03 (1.03–1.03)	<0.001
Elixhauser Comorbidity Index	1.03 (1.03–1.03)	<0.001

aOR = adjusted odds ratio.
Note. aORs >1 indicate higher adjusted odds of all-cause 30-day readmission.

Table 3
Adjusted model results showing the association between HRSN and all-cause 30-day readmissions by biological sex.

		p-values	
	aOR (95 % CI)	Simple	Interaction
Any HRSN Domain			
Male	2.03 (1.90–2.18)	<0.001	<0.001
Female	1.21 (1.08–1.34)	<0.001	
Individual HRSN Domain			
Housing			
Male	2.51 (2.32–2.72)	<0.001	0.010
Female	1.91 (1.57–2.32)	<0.001	
Employment			
Male	1.18 (0.85–1.62)	0.320	0.593
Female	1.01 (0.62–1.63)	0.974	
Family			
Male	1.15 (0.86–1.56)	0.346	0.114
Female	0.82 (0.59–1.12)	0.212	
Psychosocial			
Male	1.29 (0.81–2.05)	0.284	0.150
Female	0.53 (0.17–1.62)	0.265	
Socioeconomic			
Male	1.02 (0.86–1.22)	0.795	0.787
Female	1.06 (0.91–1.22)	0.454	

HRSN = health-related social need.
aOR = adjusted odds ratio.
Note. The interaction p-value tests whether the simple main effect for males differed from the simple main effect for females. aORs >1 indicate higher adjusted odds of all-cause 30-day readmission.

lower odds of in-hospital mortality (95 % CI: 14.0 % to 48.8 % lower, $p = .002$; 0.6 % vs. 0.9 %), 31.6 % longer length of stay (95 % CI: 27.3 % to 35.9 % longer, $p < .001$; 2.7 days vs. 2.1 days), and 14.0 % higher inflation-adjusted hospital cost (95 % CI: 11.8 % to 16.2 % higher, $p < .001$; $7986 vs. $7007).

4. Discussion

To our knowledge, this study is one of the first to evaluate the relationship between HRSN and all-cause readmission in the context of AF-specific hospitalizations using a large, nationally representative hospital readmissions database. To provide perspective on patients hospitalized for AF, the rate of readmission for primary AF was 12.5 % for prevalent AF (any AF within 1 year of the index) and 10.1 % for newly diagnosed or incident AF at the index with most of these occurring within 6 months of index AF hospitalization [22,23]. This investigation provided data on all-cause readmissions beyond primary AF and the impact of HRSN on all-cause readmissions after primary AF hospitalization.

The data in this investigation demonstrate that individuals with documented social needs have higher rates of all-cause 30-day hospital readmission following AF-specific hospitalizations compared to those without these same needs (Fig. 1). Our findings are consistent with the results of prior studies showing a direct relationship between HRSN, such as housing [24,25], transportation [26], financial insecurity [27], and hospital admissions, although these studies are not specific for AF. Overall, the coded HRSN rate among all-cause 30-day readmissions was 0.9 %, of which housing was the most prevalent factor (Fig. 2). The direct relationship between HRSN and readmission persisted even after

Table 4
Cause-specific 30-day readmission rates stratified by HRSN for hospitalizations that had a readmission.

	HRSN: No	HRSN: Yes	*p*
Conduction Disorder	24.3	31.9	<0.001
Heart Failure	12.5	12.8	0.654
Intracardiac Procedure	2.9	0.8	<0.001
Sepsis	5.7	4.9	0.121
GI Hemorrhage	2.5	1.0	<0.001
Permanent Pacemaker	2.8	0.6	<0.001
Respiratory Failure	1.5	1.0	0.067
Cardiac Catheterization	2.1	1.1	<0.001
Renal Failure	2.1	1.9	0.369
COPD	2.0	3.5	<0.001
Pneumonia	2.2	1.6	0.046

Note. Data presented as percent.

adjusting for age, biological sex, insurance type, income quartile, facility features, hospitalization characteristics, and comorbidity burden with those individuals with at least one HRSN having 2.4-times higher adjusted odds of readmission (Table 2). However, no other individual HRSN was associated with readmission (Table 2).

Males with documented HRSN had statistically significantly higher odds of readmission as compared to their female counterparts (Table 3). When this analysis was further broken down to investigate the interactions of specific HRSN and biological sex, housing remained the most prominent contributing factor to readmissions. These findings provide evidence for further investigation into the use of ICD-10 *Z*-codes to document HRSN for future interventions. Housing insecurity and sex-related differences in readmission following AF hospitalization can provide insight into areas for future focus in coordinating the transition of care. Interventions to address the provision of resources related to these HRSN may reduce the overall cost of healthcare by reducing hospital readmissions and possibly benefit communities by improving SDOH.

Previous research has described community-level determinants of health specific to AF including race and ethnicity, financial resources, rurality and neighborhood factors, health literacy, and social support [4]. However, there is a paucity of AF-specific data available for individual-level social risk factors, such as housing insecurity, food insecurity, reduced healthcare access, and cost-related barriers to prescription medication adherence [28]. AF is a common reason for initial hospital admission and its increasing prevalence necessitates consideration of HRSN in care management due to its large role in healthcare resource utilization. Our study suggests that HRSN are associated with lower odds of death, longer length of stay, and higher hospital costs at the index AF hospitalization. Higher costs may be related to longer length of stay. Given the observational and retrospective nature of the data, the lower odds of death cannot be elucidated.

Male sex as a risk factor for readmission has been noted in the literature, although not specifically in the context of AF. Beyond biological and clinical factors, this finding may be attributed to social influences on post-discharge disease management, such as gender roles, lack of social support, and underutilization of preventative healthcare. Prior studies have indicated that males are less likely to seek help compared to their female counterparts and tend to adopt a "wait and see" approach, leading to delayed medical care. This behavior may be rooted in the perception of men as caretakers of the household, the concept of masculinity, and the role of women in motivating them to seek care [29,30]. Additionally, social isolation, such as being unmarried or living alone, has been shown to contribute to readmissions for men. Studies have highlighted that social support is associated with more frequent attendance to follow-up appointments and more consistent healthcare utilization, both of which lead to shorter hospital stays and decreased risk of mortality [31,32]. For patients with cardiovascular disease, social support may even have protective effects on cardiovascular health, risk, and quality of life [33,34]. Finally, men are more likely to rely on emergency department visits as their usual source of medical care rather than preventative care. In contrast, women have greater usage and familiarity with the healthcare system due to pregnancy, breast and cervical cancer screenings, and their role in child caretaking [35]. In the context of AF, a study by Barón-Esquivias et al. in Spain found that women are more likely to experience AF symptoms, prompting more frequent medical attention [36]. This can lead to better preventative care and practices in the outpatient setting, resulting in fewer readmissions for females compared to males [37]. In summary, observed sex differences in readmission risk may be tied to social influences on post-discharge follow-up and preventative care. Further research into social factors influencing health behaviors and healthcare usage for AF patients may provide additional insights to guide care.

Housing insecurity, which includes a spectrum of housing experiences ranging from frequent moves to disproportionate housing costs relative to income to homelessness, is an important area to target for future intervention [38]. Previous literature has shown that housing insecurity is strongly associated with chronic diseases including cardiovascular diseases, increased lengths of hospital stay, higher frequency of emergency department visits, and worse access to preventative and primary care [38,39]. An article by Sims et al. revealed that the increased prevalence of barriers to cardiovascular disease care in individuals faced with housing issues further exacerbates health disparities [40]. These housing issues were categorized into four distinct domains of stability, quality and safety, affordability and accessibility, and neighborhood environment. Thus, to address the contribution of housing as a major social determinant of cardiovascular health, there needs to be a nuanced understanding of housing insecurity and a multifaceted approach addressing each of these areas in efforts to reduce the associated health inequities.

Hospitals with higher readmission rates within 30 days of discharge for specific diagnoses are penalized by the Hospital Readmission Reduction Program (HRRP) to improve hospital performance and reduce hospital readmissions. Widespread use of *Z*-codes should be encouraged for proper documentation of such patients with complex HRSN. Beginning in 2024, the Centers for Medicare and Medicaid Services mandated hospitals that report to the Inpatient Quality Reporting Program to submit measures on Social Drivers of Health. Although not the Z-codes, there is a clear focus towards documenting and reporting on social risk factors. The provision of financial incentives to hospitals may help complete documentation of these HRSN and therefore create a better assessment of their impact on healthcare outcomes. A recent review by Tsega et al. showed that the involvement of care management teams while coordinating hospital discharges helped reduce readmissions significantly with one study reporting an estimated cost saving of approximately $1700 per avoided readmission [41]. When details on HRSN are available, multidisciplinary care management teams can plan and tailor discharge plans to accommodate HRSN barriers before patients leave a facility.

In addition to imposing financial strain on patients and healthcare systems, readmissions are associated with higher morbidity, mortality, and care transition challenges. Rather than indicating increased risk of death or complications, readmissions in AF patients serve as a proxy for illness severity and signify a poorer prognosis [42]. Additionally, research from Verma et al. revealed that around 20 % of patients readmitted after an AF-specific hospitalization faced care fragmentation when presenting to an outside facility. These patients faced an elevated risk of readmission, increased disease burden, and consequently, a higher risk of mortality with longer lengths of stay. Information discontinuity during transfers of care can contribute to delays in diagnosis and treatment, resulting in worse patient outcomes [43]. These challenges are particularly pronounced in the setting of AF due to its complex clinical treatment options and associated comorbidities [44]. Further exploration of readmissions in AF care management may deepen our understanding of their implications and improve care plans.

Providing actionable data at the point of care and improving

discharge planning are key benefits of integrating HRSN considerations into care management workflows while improving health outcomes. A narrative review by Virapongse et al. noted that uncoordinated transitions of care among medically underserved populations, such as Medicaid patients, are associated with poorer health outcomes. One area of improvement is establishing the housing situation of patients before discharge as housing insecurity is associated with other barriers to care such as transportation to follow-up appointments and affordability of prescribed medications [45]. In addition to creating a smoother transition of care, incorporating information about HRSN into the electronic medical records can help to inform providers to engage in these discussions that would otherwise likely not occur.

There are several limitations of our study. Unfortunately, the data on the NRD database is dependent on reporting of *Z*-codes by providers during hospitalizations. These codes are not well-known to healthcare providers and therefore are likely to be underreported. Further, the NRD does not include information about race or ethnicity. Likewise, this study includes data from inpatient hospitalizations and therefore lacks information on emergency department and outpatient walk-in visits. In addition, the time burden associated with collecting a comprehensive social history or the lack of clinical relevance may deter providers from asking these important questions and can lead to an underestimation of the relationship between HRSN and readmissions. On the other hand, one area of potential bias contributing to the overestimation of HRSN is the variability in the frequency of coding by providers. For example, as discussed before, housing insecurity has a wide spectrum of manifestations ranging from frequent moves to homelessness. Thus, refined definitions of *Z*-codes for HRSN can help to further stratify the risks of patients and avoid overestimation of their social needs. Also, based on patient population and geographic area, some providers may work in medically underserved communities and are more aware of the issues their patients face outside of the hospital; in return, they may be more likely to code HRSN diagnoses. Together, the underreporting of *Z*-codes, coupled with an emphasis on certain social situations, may introduce selection bias in screening for SDOH. For example, clinicians in the inpatient setting may be more inclined to inquire about the housing status of patients to determine discharge plans. This inclination could lead to an underestimation of the total number of individuals with SDOH and an overestimation of certain types of needs. Consequently, this might skew the true distribution of *Z*-codes and may not entirely represent the needs of the general population.

In conclusion, there is a significant association between the number of HRSN and thus SDOH, and hospital readmissions in patients with AF. Due to AF as a common cause of initial hospital admission and its significant role in healthcare resource utilization, these findings should encourage the use of ICD-10 Z-codes to better characterize the individual social needs of patients. In order to identify the most effective interventions for preventing readmissions to inpatient hospitals, further research is required to explain the true nature of the relationship between readmission rates and individual social needs with a specific emphasis on post-discharge care management and housing insecurity. Additionally, this research can improve our understanding of how to address the complexity of social factors contributing to health disparities among patients with AF.

Author statement

All authors participated in the research and preparation of the manuscript.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Michael H. Kim, MD, MMM reports a relationship with Sanofi that includes: consulting or advisory.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ahjo.2023.100340.

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