Impact of Social Factors on Risk of Readmission or Mortality in Pneumonia and Heart Failure: Systematic Review

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BACKGROUND: Readmission and mortality after hospitalization for community-acquired pneumonia (CAP) and heart failure (HF) are publically reported. This systematic review assessed the impact of social factors on risk of readmission or mortality after hospitalization for CAP and HF—variables outside a hospital's control.
METHODS: We searched OVID, PubMed and PSYCHINFO for studies from 1980 to 2012. Eligible articles examined the association between social factors and readmission or mortality in patients hospitalized with CAP or HF. We abstracted data on study characteristics, domains of social factors examined, and presence and magnitude of associations.
RESULTS: Seventy-two articles met inclusion criteria (20 CAP, 52 HF). Most CAP studies evaluated age, gender, and race and found older age and non-White race were associated with worse outcomes. The results for gender were mixed. Few studies assessed higher level social factors, but those examined were often, but inconsistently, significantly associated with readmissions after CAP, including lower education, low income, and unemployment, and with mortality after CAP, including low income. For HF, older age was associated with worse outcomes and results for gender were mixed. Non-Whites had more readmissions after HF but decreased mortality. Again, higher level social factors were less frequently studied, but those examined were often, but inconsistently, significantly associated with readmissions, including low socioeconomic status (Medicaid insurance, low income), living situation (home stability rural address), lack of social support, being unmarried and risk behaviors (smoking, cocaine use and medical/visit non-adherence). Similar findings were observed for factors associated with mortality after HF, along with psychiatric comorbidities, lack of home resources and greater distance to hospital.
CONCLUSIONS: A broad range of social factors affect the risk of post-discharge readmission and mortality in CAP and HF. Future research on adverse events after discharge should study social determinants of health.

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INTRODUCTION

Policy makers have identified rates of readmission and mortality within 30 days after hospitalization for community-acquired pneumonia (CAP) and heart failure (HF) as indicators of quality and coordination of care.[1] While the risk of 30-day readmission and mortality would be expected to be influenced by inadequate inpatient care and discharge planning, many other patient factors likely contribute to poor outcomes. However, most risk models designed to predict readmission and mortality do not include social factors.[2] The models developed by Krumholz et al.[3–6] that are used by the Centers for Medicaid and Medicare (CMS) to profile hospitals control for disease severity, comorbidity, age and gender. According to Andersen's behavioral model,[7] many different aspects of a patient's social, behavioral, and environmental milieu could likely influence post-discharge outcomes through several different mechanisms. In fact, several studies have found that many different domains of social disadvantage may influence post-hospital outcomes in CAP and HF, such as: sociodemographics,[8,9] insurance,[10–12] social support,[13] adherence,[14] and substance abuse,[12] among others.

While prior systematic reviews have been done on predictors of readmission or mortality,[2,15,16] their focus has been primarily on the adequacy of adjustment for clinical factors such as disease severity and comorbidities or simple sociodemographic characteristics (age, sex, race). While clinicians, social workers, and case managers are well aware of the broad range of social factors that contribute to patients doing poorly after hospital discharge, no systematic review to date has sought to examine the evidence base behind this commonly held belief. The extent to which a broad range of measures of social disadvantage not within a hospital's or health system's control substan-

tially influences post-discharge outcomes has important implications for clinicians, researchers, and policy makers.

The goals of this systematic review were to: 1.) identify and categorize the general domains of social factors that could influence post-discharge outcomes; and 2.) summarize the presence and magnitude of reported associations between social factors and risk of readmission or mortality in CAP and HF.

METHODS

Search Strategy and Study Selection

We searched Ovid MEDLINE, Ovid PsycINFO, and PubMed studies published between January 1, 1980 and April 2012. Eligible articles needed to: 1) report risk of readmission and/or 30 day risk of mortality, 2) measure at least one social factor in patients hospitalized with CAP or HF, 3) have the opportunity to examine an association between risk of readmission or 30-day risk of mortality and at least one social factor, and 4) be published in a peer-reviewed English-language journal. Since our focus was *community*-acquired pneumonia, we excluded HIV-associated pneumonia, nosocomial and nursing home-acquired pneumonia. We excluded case series, case reports, and reviews.

Our search strategy had several components (See Fig. 1 for details). First, we used the following Medical Subject Headings (MeSH) terms: "readmission" and "mortality" (exploded and truncated "readmi*" and "rehosp*"), "risk" (exploded), "model*", "predict*", "use*", "util*", "risk*", "heart failure" and "pneumonia". Second, because we were interested in a range of social factors, we cast a wide net with MeSH terms (exploded) for: "sociology, insurance, homeless persons, mental disorders, street drugs, drinking behavior, smoking, health behavior, social psychology, health status, population dynamics, residence characteristics, sex distribution, health, population, family characteristics, socioeconomic factors, population characteristics, demography, age distribution, censuses, ethnic groups, population density, and population groups". We limited the search to humans, English language, and adults. The intersection of all of these searches identified 630 studies for review. Application of the inclusion and exclusion criteria yielded a total of 72 articles (20 CAP and 52 HF) in our final review.

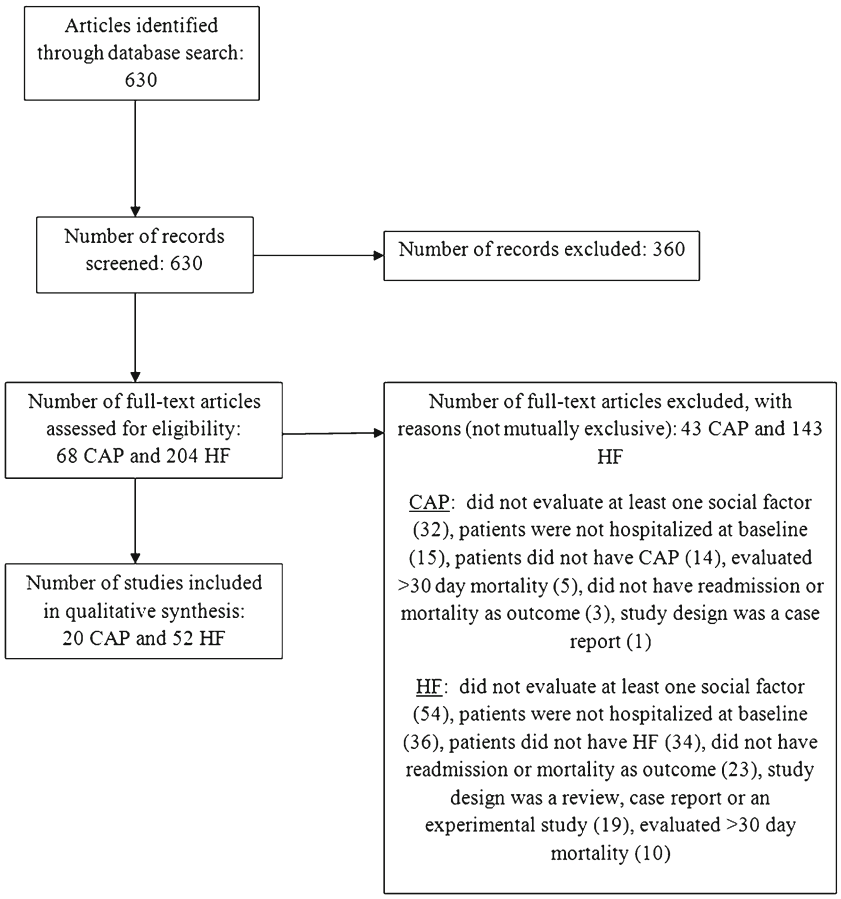

Figure 1. PRISMA flow diagram of systematic review strategy and outcomes.

Data Collection Process

These 20 CAP and 52 HF articles were reviewed in detail and abstracted by two investigators using a modified version of a previously published abstraction tool.[17] Data abstracted from each publication included: funding source, purpose, design, time period, data source, method of identifying cases, number of hospitals, hospital geographic location, statistical strategy, sample size, follow-up period, type of readmission or mortality (all-cause or disease specific), number of readmissions per patient included, and whether mortality was considered a separate or composite outcome. The type of statistical association (univariate or multivariate) between social factors and readmission or mortality was abstracted. Disagreements were resolved by consensus, or a third reviewer if necessary.

Conceptual Model of Social Factors

Because the notion of what ought to be considered a social factor is a complicated judgment, we constructed a conceptual model (See Fig. 2) outlining the diverse range of domains that could influence post-discharge outcomes, based on a review of the literature and consultation with experts in the field. We stratified social factors into three levels based on ease of measurement and mechanistic potential to directly influence post-discharge outcomes.

We classified simple sociodemographic characteristics such as age, gender, and race which are readily ascertained from most administrative databases as Level 1 factors. Level 2 factors included socioeconomic variables, such as education, employment, income, insurance, and marital status, that often require some type of additional data collection strategy (patient interview, medical record abstraction). Level 3 factors were those that relate to underlying social environment (social support, housing situation), behavioral (medication, diet, visit adherence, substance use/abuse, smoking), socio-cognitive (health literacy, language proficiency), and neighborhood (urban/rural, proximity to health care, community poverty) attributes that may more directly influence health and health care. These types of social factors usually require a more resource intensive and/or deliberate data collection strategy to be measured (patient interview, medical record

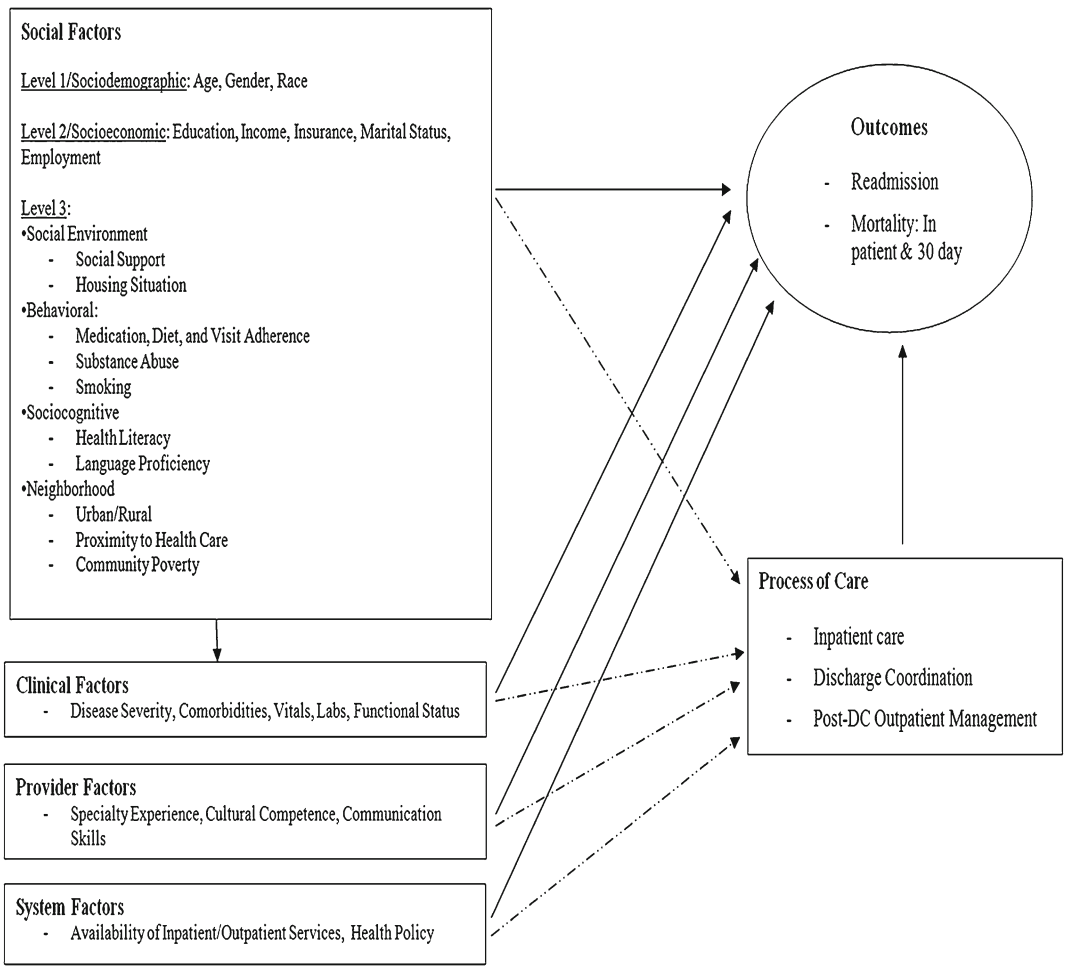

Figure 2. Conceptual model of how social factors may influence readmissions and mortality.

abstraction, geospatial databases). For example, Amarasingham et al.[12] showed the independent prognostic value of accounting for these higher level social factors in predicting the 30-day risk of readmission and mortality in HF. A review by Kansagara et al.[2] critiquing existing predictive models of readmissions highlighted that while several models included Level 1 social factors, few included Level 2 or 3 factors.

To be inclusive, our conceptual model used a broad definition of social factors that included neighborhood characteristics and highlighted the direct impact that social factors have on process of care and outcomes. Prior models have Level 3 social factors functioning as enabling factors between demographics and outcomes,[7] or have a hierarchical approach[18] to outcomes.

RESULTS

Study Selection

A total of 72 (20 CAP and 52 HF) candidate articles met our inclusion criteria and were included in our final review. A PRISMA flow diagram outlining the details of the systematic review is shown in Figure 1. The most common reasons for exclusion of candidate articles were because no social factors were evaluated, or patients were not hospitalized for the condition of interest.

Characteristics of Included Studies

The included studies varied greatly in primary purpose, design, and analytic approaches, making formal synthesis not possible. Tables 1 and 2 display the details of the included CAP and HF articles respectively. For CAP, there were 17 retrospective studies and one prospective cohort study, one cross-sectional, and one nested within a randomized control trial of an intervention. Among the 20 CAP studies, 11 were based solely on administrative data, six used a combination of administrative database and medical record review or interviews, and only three were based on directly collected social factor data from the medical record and/or interviews. Sixteen studies were based on multicenter data and four were done as single sites. The sample size for CAP studies ranged from 71 to 8,958,337 with a median of 22,746. The primary outcome was readmission for six studies (five all-cause and two CAP-specific), mortality for 15 (15 all-cause), and one study had a composite outcome of all-cause readmission and mortality.

For HF, there were 36 retrospective and 14 prospective cohort studies, one case control and one cross-sectional. Similar to CAP, most HF studies (17) were based on administrative data sets. Twenty-two used a combination of administrative database and medical record or interview, and 13 used only medical record or interview. Fourteen were single-site studies. The sample size for HF studies ranged from 54 to 8,958,337 with a median of 3,628. The primary outcome was readmission for 35 studies (18 all-cause, 14 HF-specific, 3 cardiac-specific, and one not discussed), mortality for 32 (32 all-cause and 2 cardiac-cause), and five had a composite outcome of readmission and mortality.

Social Factors Associated with Readmission in Pneumonia

Social factors that were examined in CAP readmission studies are listed in Table 3. The presence and magnitude of associations for multivariate analysis are included in the table. Most studies examined Level 1 demographic factors and found that the elderly[19,20] and non-whites[19–21] had higher readmission rates, but the impact of gender was mixed. Only five studies did multivariate analyses of higher level social factors; of these, three Level 2 variables were associated with worse outcomes. Jasti et al.[22] reported increased risk of readmission for patients with lower education and who were unemployed. McGregor et al.[23] found an increased risk of readmission for lower income patients. Of the two studies that assessed Level 3 factors, no association was seen for nursing home residence[19] or rurality.[20]

Social Factors Associated with Mortality in Pneumonia

The associations between social factors and mortality for CAP are shown in Table 4. Level 1 demographics were most commonly evaluated, and of the studies that did multivariate analyses, increased mortality was observed for older[8,16,20,24–26] and male[8,20,24] patients. The pattern for race was mixed with one study showing decreased mortality[27] for blacks and two showing no statistical difference.[27,28] Hispanics[25] and Asians[25] had lower mortality. Level 2 and 3 social factors were examined less frequently. However, those that did found that the presence of psychiatric comorbidity paradoxically decreased mortality[29] but there was no impact of income.[8] Only one Level 3 social factor, being a nursing home resident, significantly increased the odds of mortality (OR=1.5).[24] The use of alcohol,[30,31] distance to hospital[32] and urban neighborhood[20] were examined but not significantly associated with increased mortality.

Social Factors Associated with Readmission in Heart Failure

Table 5 shows the social factors that were examined in relation to readmissions in HF. There were many more HF studies that looked for sociodemographic effects. Increased readmissions were consistently seen among the elderly[33–36]

Table 1. Studies Examining the Impact of Social Factors on Risk of Readmission or Mortality in Community-Acquired Pneumonia

Source	Study Type	Data Source (Study Period)	Study Location	No. of Hospitals/ No. of Patients	Study Outcome	Follow-up Period	Analytic Model
Pearson et al. 1992[56]	Retrospective cohort	Medical Record, American Hospital Association File, Other Government Admin., (1981–1982, 1985–1986)	US	297/11,242	All-cause Mortality	30 days, 6 months	Multivariate logistic regression
Saitz et al. 1997[30]	Retrospective cohort	Massachusetts Health Data Consortium, (1992)	MA	Multiple, No. not presented / 23,198	All-cause Mortality	In Hospital	Multivariate logistic regression, Cox proportional hazards regression
Whittle et al. 1998[20]	Retrospective cohort	Medicare Administrative (1990)	PA	Multiple, No. not presented / 22,294	All-cause Mortality & Readmission	30 days*†, 3 months*	Multivariate logistic regression
Torres et al. 1998[61]	Retrospective cohort	Medical Record Review (1990–1994)	PA	Multiple, No. not presented /71	All-cause Mortality	In Hospital	Not presented
Kaplan et al. 2002[24]	Retrospective cohort	Medicare Admin., Hospital Admin., Other Government Admin., (1997)	US	Multiple, No. not presented / 623,718	All-cause Mortality	In Hospital	Multivariate logistic regression
Herzog et al. 2003 [19]	Retrospective cohort	Medicare Administrative, Medical Record, (1998–1999)	US	4,341/12,566	All-cause Mortality & Readmission	mean 6 months*†	Cox proportional hazards regression
Bohannon et al. 2003[62]	Retrospective cohort	Hospital Administrative (1999–2000)	CT	1/892	All-cause Readmission	1 year	Multivariate logistic regression
Mortensen et al. 2004[28]	Retrospective cohort	Medicare Administrative, Medical Record, (1998–1999)	PA	101/960	All-cause Mortality	30 days	Multivariate logistic regression
Oliver et al. 2004[25]	Retrospective cohort	California Hospital Discharge Data, (1996–1999)	CA	Multiple, No. not presented / 41,581	All-cause Mortality	In Hospital	Multivariate logistic regression
Vrbova et al. 2005[8]	Retrospective cohort	Other Government Administrative, (1995–2001)	Canada	Multiple, No. not presented / 60,457	All-cause Mortality	30 days, 1 year	Multivariate logistic regression, Cox proportional hazards regression
de Roux et al. 2006[31]	Prospective cohort	Medical Record, Self-Report, (1996–2001)	Spain	1/1,347	All-cause Mortality	In Hospital	Multivariate logistic regression
El-Solh et al. 2006[63]	Retrospective cohort	Medical Record, Self-Report, NY Department of Public Health, Social Security Adminstration Death Master File, (2003–2004)	NY	1/301	All-cause Mortality & Readmission Composite	1 year*†	Multivariate logistic regression, Cox proportional hazards regression
McGregor et al. 2006[23]	Retrospective cohort	Other Insurance Co. Admin., Statistics Canada Postal Code Conversion Program, Medical Record, Other Government Admin, (1990–2001)	Canada	1/434	All-cause Readmission	30 days	Multivariate logistic regression
Vaughan-Sarrazin et al. 2007[32]	Retrospective cohort	Medicare Administrative, Other Government Admin, (1996–2002)	US	Multiple, No. not presented/ 861,610	All-cause Mortality	30 days	Multivariate logistic regression
Tabak et al. 2007 [26]	Retrospective cohort	Medical Record, Cardinal Health Research Database, (2000–2003)	US	266 /824,393	All-cause Mortality	In Hospital	Boot strapping, recursive partitioning
Jasti et al. 2008[22]	RCT Cohort	Medical Record, Self-Report/Survey, RCT Cohort, (1998–1999)	PA	7/577	CAP-specific Readmission	30 days	Multivariate logistic regression
Abrams et al. 2008[29]	Retrospective cohort	VA Patient Treatment File , Outpt. Care Files Decision Support System Laboratory File, (2003–2004)	US	168/32,073	All-cause Mortality	In Hospital	Multivariate logistic regression
Polsky et al. 2008[27]	Retrospective cohort	Medicare Administrative, VA, Census Data, (1998–2004)	US	3369 /8,958,337	All-cause Mortality	30 days, 2 years	Multivariate logistic regression, Other Multivariate time to event
Ross et al. 2010[16]	Cross- Sectional	VA Patient Treatment File , Other Government Admin, (2006–2009)	US	124/31,126	All-cause Mortality	30 days	Multivariate Hierarchical Regression, boot strapping
Joynt et al. 2011[21]	Retrospective Cohort	Medicare Administrative, (2006–2008)	US	4,588 /1,236,751	All-cause & CAP-specific readmission	30 days	Multivariate Logistic Regression

*Mortality follow-up; †Readmission follow-up

Table 2. Studies Examining the Impact of Social Factors on Risk of Readmission or Mortality in Heart Failure

Source	Study Type	Data Source (Study Period)	Study Location	No. of Hospitals/ No. of Patients	Study Outcome	Follow-up Period	Analytic Model
Vinson, et al. 1990[64]	Prospective cohort	Medical Record, Self-report, (1987)	Missouri	1/140	All-cause Readmission	3 months	Univariate
Pearson et al. 1992[56]	Retrospective cohort	Medical Record, American Hospital Association File, Other Government Admin., (1981–1982, 1985–1986)	USA	297/11,242	All-cause Mortality	30 days, 6 months	Multivariate logistic regression
Krumholz et al. 1997[42]	Retrospective cohort	Medicare Administrative (1990–1994)	Connecticut	Multiple, No. not Presented / 17,448	All-cause Readmission; All-cause Readmission and Mortality Composite	6 months	Multivariate logistic regression
Philbin et al. 1998[9]	Retrospective Cohort	Medical Record, SPARCS, Other Government Admin., (1995)	New York	236/45,894	HF-specific readmission & All-cause mortality	In hospital*, 1 year†	Multivariate logistic regression
Philbin et al. 1998[11]	Retrospective cohort	Medical Record, SPARCS, Other Government Admin., (1995)	New York	243/43,157	All-cause Mortality & Readmission	6 months*†	Multivariate logistic regression
Ni et al. 1998[57]	Retrospective Cohort	Oregon Association of Hospital and Health Systems, (1995)	Oregon	Multiple, No. not Presented / 5,821	HF-specific readmission & All-cause Mortality	In hospital*, 3 months†	Multivariate Logistic regression
Afzal et al. 1999[65]	Prospective cohort	Medical Record, Self-Report, (1999)	Michigan	1/163	type of readmission not discussed	6 months	Multivariate logistic regression
Philbin et al. 1999[10]	Retrospective cohort	Medical Record, SPARCS, Other Government Admin., (1995)	New York	236/42,731	HF-specific Readmission	6 months	Multivariate logistic regression
Kossovsky et al. 2000[34]	Case–control	Hospital Administrative, Medical Record, (1993–1998)	Switzerland	1/442	All-cause & HF-specific Readmission	1 month	Multivariate logistic regression
Krumholz et al. 2000[66]	Retrospective cohort	Medicare Administrative, Hospital Administrative, Medical Record, (1994–1995)	Connecticut	18/2,176	All-cause & HF-specific Readmission	6 months	Multivariate logistic regression
Struthers et al. 2000[48]	Retrospective cohort	Hospital Administrative, Medical Record, (1989– 1994)	UK	Multiple, No. not presented/478	All-cause Mortality & Readmission; Cardiac Readmission	2 years*†	Cox proportional hazards regression
Philbin et al. 2001[44]	Retrospective cohort	Medical Record, SPARCS, Other Government Admin., (1995)	New York	236/41,776	HF-specific Readmission	one year	Multivariate logistic regression
Jiang et al. 2001[33]	Prospective cohort	Medical Record (1997–1998)	North Carolina	1/374	All-cause Mortality & Readmission	3 months*†, 1 year*†	Multivariate logistic regression, Cox proportional hazards regression
Tsuchihashi et al. 2001[46]	Prospective cohort	Hospital Administrative, Medical Record, Self-Report, (1997– 1999)	Japan	5/230	All-cause & cardiac mortality, HF-specific Readmission	mean 2.4 years*†	Multivariate logistic regression
Rathore et al. 2003[37]	Retrospective cohort	Medical Record, Survey, Medicare Administrative, (1998–1999)	USA	Multiple, No. not presented / 29,732	All-cause Mortality & Readmission	30 days*, 1 year*†	Multivariate logistic regression, Multivariate hierarchical regression
Feinglass et al. 2003[51]	Retrospective cohort	Hospital Admin, Other Government Admin., (1989–2001)	Illinois	1/2,323	All-cause Mortality	1 month; 1, 3, & 5 years	Cox proportional hazards regression
Luthi et al. 2003[41]	Retrospective cohort	Medical Record, Medicare Administrative, (1995–1996)	Connecticut, Georgia, Oklahoma, Colorado, Virginia	50/611	All-cause Readmission	21 months	MV logistic regression, Cox proportional hazards regression, MV Hierarchical regression
Chen et al. 2003[67]	Retrospective cohort	Medical Record (1986–1999)	Taiwan	1/234	All-cause Mortality	In Hospital	Multivariate logistic regression
Schwarz et al. 2003[13]	Prospective cohort	Medical Record, Self-Report, (not listed)	Ohio	2/156	All-cause Mortality & Readmission	3 Months*†	Cox proportional hazards regression
Opasich et al. 2003[35]	Prospective Cohort	Hospital Medical Record, Self-Report, Survey, (2000)	Italy	417/2,127	All-cause Mortality	In hospital	Multivariate logistic regression
Zuccala et al. 2003[55]	Retrospective cohort	RCT cohort, (1988, 1991, 1993, 1995, 1997)	Italy	81/1,113	All-cause Mortality	In hospital, 1 year	Cox proportional hazards regression

Table 2. (continued)

Source	Study Type	Data Source (Study Period)	Study Location	No. of Hospitals/ No. of Patients	Study Outcome	Follow-up Period	Analytic Model
Lee et al. 2003[53]	Retrospective cohort	Medical Record, Other Government Admin., (1997–2001)	Canada	48/4,031	All-cause Mortality	30 days, one year	MV logistic regression, Boot strap
Formiga et al. 2006[68]	Prospective cohort	Medical Record (2001–2002)	Spain	1/88	HF-specific Readmission, All cardiac mortality	30 days*† 1 year*†	Univariate
Goldberg et al. 2005[54]	Retrospective cohort	Medical Record (2000)	Massachusetts	11/2,604	All-cause Mortality	In Hospital	Multivariate logistic regression
Luttik et al. 2006[69]	Retrospective cohort	Hospital Administrative, Medical Record, Self-Report, RCT, (1994– 1997)	Netherlands	1/179	All-cause Mortality & Readmission Composite	9 months*†	Multivariate logistic regression
Rathore et al. 2006[45]	Retrospective	Medicare Administrative, (1998–1999)	USA	Multiple, No. not	All-cause Mortality &	30 day*,	MV hierarchical
Garty et al. 2007[52]	Prospective cohort	Medical Record, Other Government Admin, Self-Report, (2003–2004)	Israel	25/4,102	All-cause Mortality	In Hospital, 1 & 3 months, 1 year	Multivariate logistic regression
Tabak et al. 2007[26]	Retrospective cohort	Medical Record, Cardinal Health Research Database, (2000–2003)	USA	266/824,393	All-cause Mortality	In Hospital	boot strapping, recursive partitioning
Vaughan-, Sarrazin et al. 2007[32]	Retrospective cohort	Medicare Administrative, Other Government Admin, (1996–2002)	USA	Multiple, No. not presented / 861,610	All-cause Mortality	30 days	Multivariate logistic regression
Howie-Esquivel et al. 2007[70]	Prospective Cohort	Medical Record, Self-Report, (2004–2005)	California	1/84	HF-specific and cardiac readmission	3 months	Cox proportional hazards regression
Najafi et al. 2007[71]	Retrospective cohort	Other Government Admin, (1996–1999,2003–2004)	Australia	Multiple, No. not presented / 1,161,526	All-cause Mortality	In hospital	Multivariate logistic regression
Roe-Prior et al. 2007[36]	Retrospective cohort	Self-Report, RCT cohort, (1994–2004)	Pennsylvania	4/103	All-cause & HF-specific Readmission	3 months	Multivariate logistic regression
Abrams et al. 2008[29]	Retrospective cohort	VA Patient Treatment File , Outpt Care Files Decision Support System Laboratory File, (2003–2004)	USA	168/32,073	All-cause Mortality	In Hospital	Multivariate logistic regression
Howie-Esquivel et al. 2008[43]	Prospective cohort	Medical Record, Self-Report, (2004–2005)	California	1/54	HF-specific and cardiac readmission	3 months	Cox proportional hazards regression
Fonarrow et al. 2008[58]	Prospective cohort	OPTIMIZE-HF Registry (2003–2004)	USA	259/48,612	All-cause Mortality & All-cause Mortality and Readmission composite	In Hospital*, 2,3 months*†	Multivariate logistic regression, Cox proportional hazards regression
Mullens et al. 2008[72]	Retrospective cohort	Medical Record, Other Government Admin, (2000–2006)	Ohio	1/278	All-cause Mortality & HF-Specific Readmission	median 54 months*†	Cox proportional hazards regression
Polsky et al. 2008[27]	Retrospective cohort	Medicare Administrative, VA, Census Data, (1998–2004)	USA	3,369 /8,958,337	All-cause Mortality	30 days, 2 years	Multivariate logistic regression, Other Multivariate time to event
Albert et al. 2009[47]	Retrospective Cohort	OPTIMIZE-HF Registry (2003– 2004)	USA	259/48,612	All-cause Mortality; Mortality & Readmission Composite	In Hospital*, 2,3 Months*†	Cox proportional hazards regression
Ambardekar et al. 2009[59]	Retrospective Cohort	GWTG-HR Registry (2005–2007)	USA	236/54,322	All-cause Mortality	In hospital	Multivariable logistic regression
Aranda et al. 2009[40]	Retrospective Cohort	Medicare Administrative (2002–2004)	USA	Multiple, No. not presented / 28,919	All-cause Readmission	6 & 9 months	Multivariable logistic regression
Lofvenmark et al. 2009[73]	Prospective Cohort	Medical Record, Self-Report, (2006–2007)	Stockholm	1/149	All-cause Readmission	1 year	Multivariable logistic regression
Moser et al. 2009[74]	Retrospective cohort	Self-Report, RCT cohort, (not discussed)	USA & Canada	26/425	All-cause Mortality & Readmission Composite	6 months*†	Cox proportional hazards regression
Saczynski et al. 2009[50]	Retrospective cohort	Medical Record, Other Government Admin., (1995–2000)	Massachusetts	11/4,534	All-cause Mortality	In Hospital, 30 days, one year	Multivariate logistic regression, Cox proportional hazards regression

Table 2. (continued)

Source	Study Type	Data Source (Study Period)	Study Location	No. of Hospitals/ No. of Patients	Study Outcome	Follow-up Period	Analytic Model
Ross et al. 2010[16]	Cross-Sectional	VA Patient Treatment File, Other Government Admin, (2006–2009)	USA	124/26,379	All-cause Mortality	30 days	Multivariable Hierarchical Regression, boot strapping
Amarasing- ham et al. 2010[12]	Retrospective Cohort	Medical Record, Other Government Admin., (2007–2008)	Texas	1/1,372	All-cause Mortality & Readmission	30 days	Multivariate logistic regression, bootstrapping
Kociol et al. 2010[38]	Retrospective Cohort	Medicare Administrative, OPTIMIZE-HF Registry, (2003–2005)	USA	259/20,063	All-cause Mortality & Readmission	1 year*†	Cox proportional hazards regression
Muus et al. 2010[75]	Retrospective Cohort	VA Patient Treatment File , Other Government Admin, (2005–2007)	USA	Multiple, No. not presented / 36,566	HF-specific Readmission	30 days	Multivariate logistic regression
Chioncel et al. 2011[49]	Prospective Cohort	Hospital Medical Record (2008–2009)	Romania	13/3,224	All-cause Mortality	In hospital	Multivariate logistic regression
Joynt et al. 2011[21]	Retrospective Cohort	Medicare Administrative, (2006–2008)	USA	4,560 /1,346,768	All-cause & HF specific Readmission	30 days	Multivariate logistic regression
Rodriguez et al. 2011[39]	Retrospective Cohort	Medicare Administrative, American Hospital Assoc., Hospital Quality Alliance, (2006–2008)	USA	4,550 /1,734,101	All-cause Readmission	30 days	Multivariate logistic regression
Watson et al. 2011[14]	Retrospective Cohort	Hospital Medical Record, (2007–2008)	Massachusetts	1/729	All-cause Readmission	30 days	Multivariate logistic regression
Zuluaga et al. 2011[60]	Prospective Cohort	Self-Report, Hospital Medical Record, Other Government Admin, (2000–2005)	Spain	4/433	All-cause Mortality	5 years	Cox proportional hazards regression

*Mortality follow-up; †Readmission follow-up

and blacks,[9,10,21,37,38] Hispanics[39] also did worse. The results for gender were very mixed; five studies found no effect,[13,14,38,40,41] two studies found that men did worse,[12,42] and one that men did better.[43]

Many Level 2 factors increased the risk of readmission in HF. Patients with Medicare[10,12] or Medicaid[10,11] had 59 % to 92 % greater odds of readmission (See Table 5 for details). Being unmarried[36] or single[12] increased readmissions. Several related measures of low socioeconomic[44–46] status were found to significantly increase readmission, or showed similar borderline trends.[12,36] Comorbid depression was borderline in three,[12,33,47] and not associated[14,38] with readmission in two others. The mental health comorbidity examined the most was depression; the odds ratio for these studies ranged from 1.21 to 1.83.

Compared to CAP, more HF studies evaluated Level 3 domains. In the social environment domain, Schwarz et al.[13] showed that social support decreased readmission, but Struthers et al.[48] showed no effect of social deprivation. As a measure of home stability, Amarasingham et al.[12] showed that patients with more home address changes in the prior year were at increased risk of readmission. Behavioral factors significantly related to outcomes included smoking[38] and cocaine[12] use. Several measures of patient non-adherence were also associated with readmission, such as: a missed post-discharge follow-up appointment,[14] non-adherence to the medical plan,[14] and declining medical service as inpatient.[14] In the socio-cognitive domain, there were no demonstrated language proficiency effects.[14] Patients living in a rural setting had fewer readmissions.[10]

Social Factors Associated with Mortality in Heart Failure

The associations between social factors and short-term mortality in HF are shown in Table 6. Level 1 factors showed increased mortality in older[16,26,49–53] patients, while the results for gender were mixed, with three studies showing no difference,[16,54,55] three showing increased mortality,[9,51,56] and one decreased[52] mortality. Black HF patients had decreased mortality.[9,27,37,51]

Level 2 factors that were examined but were not significant included insurance,[57] education,[55] and socioeconomic status.[45] Abrams et al.[29] showed that patients with a psychiatric comorbidity had decreased odds of mortality. Level 3 factors examined included non-adherence behavior; diet non-adherence[58] and medical plan non-adherence[59] were associated with decreased short-term mortality, while medication non-adherence[58] showed no difference. Living closer to a hospital[32] decreased mortality. In the social environment domain, Zuluaga et al.[60] examined the impact of housing resources on mortality, and found that not having an elevator and frequently feeling cold at home were associated with increased mortality.

Table 3. Association between Social Factors and Readmission in Community-Acquired Pneumonia

Social Factor	Variable Examined	Significant UV association/ UV analysis done	Significant MV association/ MV analysis done	MV Magnitude of Association‡ Ratio (95 % CI), p value
Level 1 Factors				
Age[19,20,22,23,62,63]	6	1/4	1/4	age per year HR=0.94 (0.91–0.97), <0.0002[19] 80–84 OR=1.14 (0.98–1.32), (NS)[20] ≥65 OR=2.7 (0.3–21.6), (NS)[22] not specified (no ratio, NS)[63]
Gender[19,20,23,62,63]	5	2/3	4/4	Male OR=0.675 (0.52–0.88), 0.004[62] Male OR=1.21 (1.11–1.32)[20] Male OR=2.05 (1.01–4.18)[23] Male HR=0.59 (0.56–0.63), <0.0001[19]
Race[19–21,62]	4	1/2	2/3	Black OR=1.15 (1.12–1.17), <0.001[21] Black OR=1.25 (1.05–1.49)[20] Non-white HR=1.05 (0.96–1.14), 0.23, (NS)[19]
Level 2 Factors				
Education[22]	1	1/1	1/1	<high school OR=2 (1.1–3.4), <0.05[22]
Employment[22]	1	1/1	1/1	unemployed OR=3.7 (1.1–12.3), <0.05[22]
Income[23]	1	0/0	1/1	On income assistance OR=2.65 (1.38–5.09), <0.01[23]
Level 3 Factors				
Social Environment				
Living Status[23]	1	0/0	0/0	N/A
NH resident[19]	1	0/0	0/1	NH HR=1.0 (0.92–1.08), 0.96, (NS)[19]
Behavioral				
Smoking[23,63]	2	0/0	0/0	N/A
Substance Abuse[23]	1	0/0	0/0	N/A
Neighborhood				
Urban vs. Rural[20]	1	0/1	0/1	Urban OR=1.02 (0.91–1.15) , (NS)[20]

UV univariate analysis, *MV* multivariate analysis, *NH* nursing home, *N/A* not applicable, *NS* not significant; ‡data reported varies based on information available in primary study, not all studies reported CI or p values

Table 4. Association between Social Factors and Mortality* in Community-Acquired Pneumonia

Social Factor	Variable Examined	Significant UV association/ UV analysis done	Significant MV association/ MV analysis done	MV Magnitude of Association‡ Ratio (95 % CI), p-value
Level 1 Factors				
Age[8,16,20,24–26,28,29,31,32,61]	11	4/5	7/7	>65 OR=1.05 (1.04–1.05)[16] ≥81 OR=0.95 (0.92–0.97), <0.001[32] ≥85 OR=2.66 (2.33–3.04)[20] ≥85 OR=3.02 (2.83–3.21), <0.0001[8] ≥90 OR=1.75 (1.69–1.81)[24] ≥100 OR=10.56 (6.22–17.9)[25] Age per year OR=1.035 (1.02–1.04), <0.0001[26]
Gender[8,16,20,24–26,28,29,31,32,56]	11	3/4	3/6	Male OR=1.15 (1.13–1.17)[24] Male OR=1.23 (1.15–1.33)[20] Male OR=1.28 (1.22–1.34), <0.0001[8] Male OR=1.02 (0.96–1.08), (NS)[25] Male OR=1.31 (0.99–1.73), (NS)[16] Male mean rate difference +0.2 (−2.2-+2.7)[56]
Race[20,25,27–29,32]	6	1/3	2/4	Black mean rate difference −1.7, p value <0.05[27] Black OR=0.40 (0.16–1.0), (NS)[28] Black OR=1.06 (0.91–1.24), (NS)[20] Asian OR=0.83 (0.75–0.91)[25]
Hispanic ethnicity[25]	1	1/1	1/1	Hispanic OR=0.9 (0.82–0.98)[25]
Level 2 Factors				
Insurance[32]	1	0/0	0/0	N/A
Mental Health[29]	1	1/1	1/1	Psychiatric comorbidity OR=0.63 (0.52–0.77), <0.001[29]
Income[8,32]	2	0/0	0/1	Low Income OR=1.04 (0.97–1.12), 0.23, (NS)[8]
Level 3 Factors				
Social Environment				
NH resident[24]	1	1/1	1/1	NH=OR 1.5 (1.44–1.55)[24]
Behavioral				
Smoking[31]	1	0/1	0/0	N/A
Alcohol[30,31]	2	1/2	0/2	alcohol use OR=1.0 (0.7–1.4), (NS)[30] not specified (no ratio, NS)[31]
Neighborhood				
Urban v. Rural[20]	1	1/1	0/1	Urban OR=1.08 (0.98–1.2), (NS)[20]
Distance to hospital[32]	1	0/0	0/1	≤25 miles OR=1.0 (0.99–1.01), 0.77, (NS)[32]

*Results shown are only for short-term mortality (≤30 days post-discharge or in hospital); *UV* univariate analysis, *MV* multivariate analysis, *NH* nursing home, *N/A* not applicable, *NS* not significant; ‡data reported varies based on information available in primary study, not all studies reported CI or p values

Table 5. Association Between Social Factors and Readmission in Heart Failure

Social Factor	Variable Examined	Significant UV association/ UV analysis done	Significant MV association/ MV analysis done	MV Magnitude of Association‡ Ratio (95 % CI), p value
Level 1 Factors				
Age[9–14,33–38,40–46,48,57,58,64–66,68–70,72–76]	33	6/14	4/10	65–74 OR=0.83 (0.75–0.91)[40] ≥80 OR=4.1 (1.6–11), 0.004[34] Age per year OR=1.03 (1.012–1.05), 0.002[33] Age per year OR=1.05 (1.03–1.08)[35] Age per year OR 1.17, 0.021[36] >65yo OR=1.45 (0.83–2.55), 0.2, (NS)[14] 75–84 OR=1.08 (1–1.16), (NS)[42] ≥80 HR=1.05 (0.99–1.12), 0.13, (NS)[38] Age per year HR=0.97 (0.92–1.02), (NS)[13] Age per year HR=1.03 (0.99–1.06), 0.117, (NS)[74]
Gender[9–14,34–38,40–46,48,57,58,64–66,68–70,72,73,75]	30	3/15	4/8	Male OR=1.12 (1.05–1.2)[42] Male OR=1.37 (1.02–1.84), 0.03[12] Male HR=0.40 (0.16–0.96), 0.04[43] Male OR=1.00 (0.94–1.06), (NS)[40] Male OR=1.07 (0.66–1.74), 0.78, (NS)[14] Male HR=0.98 (0.94–1.02), 0.37, (NS)[38] Male HR=1.23 (0.64–2.36), (NS)[13] Male rate ratio 1.2 (0.96–1.49), (NS)[41]
Race[12,21,38,40,65,759–11,36,37,41–45,58,64,66,70,72]	21	7/10	6/8	Black OR=1.04 (1.03–1.06), <0.001[21] Black OR=1.28 (1.16–1.41)[10] Black OR=1.30 (1.22–1.39), 0.0001[9] Black HR=1.24 (1.17–1.33), <0.001[38] Black RR=1.09 (1.06–1.13)[37] Black OR=1.05 (0.97–1.14), (NS)[40] Non-white OR=0.88 (0.78–1.01), (NS)[42] not specified (no ratio, NS)[65]
Ethnicity[39,70]	2	1/1	1/1	Hispanic OR=1.11 (1.07–1.14), <0.001[39]
Level 2 Factors				
Insurance[9–12,14,57,65]	7	3/4	3/4	Medicaid OR=1.74 (1.4–2.16), <0.01[11] Medicaid OR=1.92 (1.57–2.36)[10] Medicare OR=1.59 (1.17–2.17), 0.004[12] Medicare OR=1.66 (1.38–2)[10] Public insurance OR=0.61 (0.34–1.07), 0.08, (NS)[14]
Marital Status[12,14,36,43,46,69,73,75]	8	1/4	2/3	Not married OR=1.28, 0.021[36] Single OR=1.47 (1.08–2.01), 0.02[12] Not married OR=0.72 (0.45–1.15), 0.17, (NS)[14]
Mental Health[12,14,33,77]	5	2/4	2/5	Depression OR=1.44 (1–2.07), 0.05, (NS)[12] Depression OR=1.21 (0.99–1.47), 0.06, (NS)[47] Depression OR=1.83 (0.93–3.57), 0.08, (NS)[33] Depression OR=1.14 (0.68–1.91), 0.62, (NS)[14] Depression HR=1.03 (0.98–1.09), 0.25, (NS)[38] Anxiety OR=0.97 (0.58–1.62), 0.87, (NS)[14]
Education[13,36,65,73]	4	0/0	0/2	Lower Education OR 1.2, 0.11, (NS)[36] High School Graduate HR=0.51 (0.25–1.02), (NS)[13]
Income[36,44,46,75]	4	1/3	1/2	Lower Income OR=1.18 (1.1–1.26), <0.0001[44] Lower Income OR=1.18, 0.06, (NS)[36]
Socioeconomic Status[12,45,69]	3	2/2	1/2	Lower SES RR=1.08 (1.03–1.12), <0.001[45] Lower SES OR=1.3 (0.98–1.74), 0.08, (NS)[12]
Employment[36,46,65]	3	1/1	1/1	Unemployed OR=2.59 (1.22–5.48), 0.013[46]
Level 3 Factors				
Social Environment				
Social Support[13,48,64]	3	1/2	1/2	Higher Social Support HR=0.93 (0.89–0.98), <0.001[13] Social Deprivation RR=1.013 (0.94–1.1), 0.74, (NS)[48]
Living Status[34,46,68]	3	0/2	0/0	N/A
Nursing home resident[44]	1	0/0	0/0	N/A
Loneliness[73]	1	1/1	0/0	N/A
No. of home address changes in prior year[12]	1	1/1	1/1	More changes OR=1.13 (1.07–1.19), <0.001[12]
Behavioral				
Left Against Medical Advice[10–12]	3	1/1	0/0	N/A
Smoking[38,41,43,58,64,65,72]	7	0/1	1/1	Smoker HR=1.07 (1.01–1.13), 0.03[38]
Substance Abuse[10,12]	2	1/1	1/1	Cocaine use OR=1.78 (1.17–2.72), 0.01[12]
Alcohol[10]	1	0/0	0/0	N/A
Adherence w/follow-up visit[12,14,65]	3	2/2	1/2	Missed appt. OR=1.73 (1.06–2.8), 0.03[14] Missed appt. OR=1.35 (0.99–1.83), 0.06, (NS)[12]
Medical adherence[14]	1	1/1	1/1	Non-adherence OR=1.72 (1.07–2.76), 0.03[14]
Decline medical service[14]	1	1/1	1/1	Decline OR=1.75 (1.07–2.87), 0.03[14]
Adherence to diet[58,64]	2	0/0	0/1	Non-adherence OR=0.94 (0.73–1.21), 0.62, (NS)[58]
Medication adherence[58,64]	2	0/0	0/1	Non-adherence OR=1.03 (0.82–1.29), 0.8, (NS)[58]
Sociocognitive				
English proficiency[14]	1	0/1	0/1	Spanish OR=0.97 (0.27–3.56), (NS)[14] Italian OR=1.64 (0.31–8.6), (NS)[14]
Neighborhood				
Urban vs. Rural[10,11,44,75]	4	0/2	1/1	Rural OR=0.87 (0.78–0.98)[10]

UV univariate analysis, *MV* multivariate analysis, *NH* nursing home, *N/A* not applicable, *NS* not significant; ‡data reported varies based on information available in primary study, not all studies reported CI or p values

Table 6. Association Between Social Factors and Mortality* in Heart Failure

Social Factor	Variable Examined	Significant UV association/ UV analysis done	Significant MV association/ MV analysis done	MV Magnitude of Association‡ Ratio (95 % CI), p value
Level 1 Factors				
Age[9,16,26,29,32,37,45,49–55,57–59,67,68,71]	19	2/4	9/11	>65 OR=1.05 (1.04–1.05)[16] ≥80 RR=1.5 (1.3–1.6), <0.0001[51] ≥81 OR=0.92 (0.89–0.95), <0.001[32] ≥85 OR=2.99 (1.97–4.52)[50] Age per year OR=1.034 (1.02–1.04), <0.0001[26] Age per year OR=1.063 (1.03–1.1), <0.001[49] Age per year OR=1.39 (1.19–1.63)[52] Age per year OR=1.7 (1.45–1.99), <0.001[53] Age per year, <0.05[58] ≥85 OR=2.38 (0.69–8.2) , (NS)[54] Age per year RR=1.01 (0.98–1.04), (NS)[55]
Gender[9,16,26,29,32,37,45,50–59,67,68,71]	20	1/4	3/7	Male OR=0.50 (0.36–0.70)[52] Male OR=1.12 (1.05–1.23), 0.0008[9] Male RR=1.3 (1.2–1.4), <0.0001[51] Male, <0.001[71] Male mean rate difference +1.4 (−1.2-+4.0)[56] Male OR=0.94 (0.63–1.4), (NS)[54] Male OR=1.0 (0.73–1.37), (NS)[16] Male RR=0.79 (0.51–1.25), (NS)[55]
Race[9,27,29,32,37,45,50,51,58,59]	10	3/3	4/4	Black=OR 0.83 (0.73–0.94), 0.003[9] Black=RR 0.69 (0.59–0.8), <0.0001[51] Black=RR 0.78 (0.68–0.91)[37] Black mean rate difference −1.7, p value <0.05[27]
Level 2 Factors				
Insurance[9,32,57,59]	4	0/0	0/1	Medicaid=OR 0.66 (0.3–1.4), 0.68, (NS)[57]
Mental Health[29,47]	2	1/2	1/2	Psychiatric comorbidity OR=0.7 (0.57–0.86), <0.001[29]
Depression OR=1.1 (0.9–1.34), 0.35, (NS)[47]				
Education[55]	1	0/0	0/1	Education RR=1.05 (0.98–1.12), (NS)[55]
Income[32]	1	0/0	0/0	N/A
Socioeconomic Status[45]	1	0/1	0/1	Lower SES RR=1.13 (0.92–1.38), 0.26, (NS)[45]
Level 3 Factors				
Social Environment				
Living Status[60,68]	2	1/2	1/1	No elevator HR=1.39 (1.07–1.8), <0.05[60] Frequently feels cold HR 1.39 (1.01–1.92), <0.05[60] No indoor bathroom HR=0.7 (0.24–2), (NS)[60] No bathtub/shower HR=1.0 (0.41–2.32), (NS)[60] No washing machine HR=1.09 (0.52–2.27), (NS)[60] No hot water HR=1.11 (0.55–2.24), (NS)[60] No phone HR 1.37 (0.71–2.64), (NS)[60] No individual bedroom HR=1.6 (1.0–2.6), (NS)[60]
Behavioral				
Smoking[50,58,67]	3	0/0	0/0	N/A
Alcohol[67]	1	0/0	0/0	N/A
Adherence to diet[58]	1	0/0	0/1	Non-adherence OR=0.69 (0.48–1), 0.05, (NS)[58]
Medication adherence[58]	1	0/0	0/1	Non-adherence OR=0.88 (0.67–1.17), 0.39, (NS)[58]
Medical adherence[59]	1	1/1	1/1	Non-adherence OR=0.66 (0.51–0.86), 0.0017[59]
Neighborhood				
Distance to hospital[32]	1	0/0	1/1	≤25 miles OR=0.95 (0.92–0.98), 0.002[32]

*Results shown are only for short-term mortality (≤30 days post-discharge or in hospital); *UV* univariate analysis, *MV* multivariate analysis, *N/A* not applicable, *NS* not significant; ‡ data reported varies based on information available in primary study, not all studies reported CI or p values

COMMENTS

Our systematic review identified 72 studies that had some information on the impact of social factors on risk of readmission or mortality in patients with CAP and HF, but these varied widely in purpose, design, data sources, outcomes, how social factors were defined and ascertained, and degree of analytic sophistication. The heterogeneity of the studies and mixed findings made it difficult to synthesize the results and definitively assess the impact of a given social factor on outcomes. Despite these variations and uncertainties, a broad spectrum of social factors were associated with worse outcomes in two common but different conditions: CAP, an acute infectious illness, and HF, a chronic disease with acute exacerbations.

There were some themes across conditions and outcomes. Among Level 1 sociodemographic characteristics, older age was clearly the most consistent risk factor. Findings of disparities by race/ethnicity or gender were very mixed. Among Level 2 factors, various measures of low socioeconomic status (low income, education, Medicaid insurance) clearly increased risk. While few studies examined the same Level 3 variables, there was proof of concept evidence that social environment (housing stability, social support), behavioral (adherence, smoking, substance abuse), socio-cognitive (language proficiency), and neighborhood (rurality, distance

to hospital) factors were independent predictors of poor post-hospital outcomes.

Our review confirms and extends the findings of a systematic review by Ross et al.,[17] which also found that several Level 1 and a few Level 2 social factors were associated with readmissions among patients with HF, though the magnitude of association was not listed. Our review extends this finding to mortality in HF patients, to patients with CAP, and has uncovered important prognostic relationships with a broader range of social disadvantage constructs. These findings also provide empirical evidence for our proposed conceptual model and the commonly held belief that a spectrum of different level social factors influence post-discharge readmissions and mortality.

CMS publically reports on and compares hospitals according to 30-day readmission and mortality rates for CAP and HF, among other conditions.[3–6] At present, the current CMS readmission and mortality models for CAP and HF do not adjust for any Level 2 and 3 social factors identified in this review. Future research should attempt to take into account more of these other social factors that may affect adverse outcomes, but are not within the providers control and are independent of the quality of inpatient care and discharge coordination.

Several limitations of this review are worth noting. Because we considered social factors very broadly and definitions of these constructs vary, our search strategy may have missed some articles because there is not one global MeSH term on this topic. To minimize this risk, we searched for a large number of MeSH terms and keywords based on input of the literature, clinical experts and an expert medical librarian. The impact of social factors was often not the primary focus of the included studies, explaining why many did not assess this in depth or with sophisticated multivariate techniques. Finally, since many studies collected information on social factors but did not statistically analyze them or only performed univariate analysis, it is also possible that negative results were not reported because they were not statistically significant.

Future research should focus on the impact of Level 2 and 3 social factors on readmission and mortality, and seek to identify the independent contribution of different sociodemographic, socioeconomic, social environment, behavioral, socio-cognitive, and neighborhood attributes on risk of readmission and mortality. Given the dramatic growth in hospital adoption of electronic medical records (EMR), which often contain richer data on these different social domains, there should now be more opportunities than ever to examine these issues in greater depth with large patient populations, and in a way not possible with administrative billing databases. For example, a recent study by Amarasingham et al.[12] developed a readmission and mortality prediction model leveraging a wide range of social disadvantage factors extractable from the EMR and census track data. This study showed that the addition of several Level 2 and 3 social disadvantage variables to a clinical severity model significantly improved model performance and surpassed the CMS HF readmission model. There are also initiatives underway for hospitals to screen for and document in the EMR key prognostic attributes, such as language proficiency, health literacy, and social support, during the nursing intake or discharge planning process. Thus, additional measures of social disadvantage are likely to become more readily ascertainable through electronic means.

Finally, from a clinical and quality improvement perspective, the different social disadvantage prognostic factors outlined in this review could be used by physicians, case managers and discharge planners to identify patients who may be at particularly high risk of readmission and mortality because of non-clinical, vulnerability factors. Different and more intensive follow-up strategies will likely be necessary in these high social risk patients to substantially reduce their chance of poor post-discharge outcomes.

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