OPEN

Screening for Social Risk Factors in the ICU During the Pandemic

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IMPORTANCE: Due to limitations in data collected through electronic health records, the social risk factors (SRFs) that predate severe illness and restrict access to critical care services are poorly understood.

OBJECTIVES: This study explored the feasibility and utility of directly eliciting SRFs in the ICU by implementing a screening program.

DESIGN, SETTING, AND PARTICIPANTS: Five hundred sixty-six critically ill patients at the medical ICU of Robert Wood Johnson University Hospital from July 1, 2019, to September 31, 2021, were interviewed for SRFs using an adapted version of the American Academy of Family Physicians' Social Needs Screening Tool.

MAIN OUTCOMES AND MEASURES: For each SRFs, we compared basic demographic factors, proxies of socioeconomic status, and severity score between those with and without the SRFs through chi-square tests and Wilcoxon rank-sum tests. Furthermore, we determined the prevalence of SRFs overall, before, and during the COVID-19 pandemic.

RESULTS: Of critically ill patients, 39.58% reported at least one SRF. Age, zipcode matched median household income, and insurance type differed depending on the SRFs. Notably, patients with SRFs were admitted with a lower average severity score, indicating reduced risk in mortality. Since March 2020, the prevalence of SRFs in the ICU overall fell from 54.47% to 35.44%. Conversely, the proportion of patients unable to afford healthcare increased statistically significantly from 7.32% to 18.06%.

CONCLUSIONS AND RELEVANCE: Screening for SRFs in the ICU detected the presence of disproportionally low-risk patients whose access to critical care services became restricted throughout the pandemic.

Social determinants of health (SDOH) are defined by the World Health Organization as "the conditions in which people are born, grow, live, work, and age" (1). When SDOH are responsible for premature morbidity and mortality, they are referred to as social risk factors (SRFs) (2). Modifiable SDOH—shaped by culture, policy, and institutions—have been found to outperform measures of access and quality of clinical care in predicting longevity and well-being (3). However, a minority of hospitals and physician practices alike identify and address SRFs (4). The reluctance to consider SDOH beyond basic sociodemographic data (e.g., age, race, and gender) and reliance on physician notes to record SRFs reflect a lack of standardized assessment tools and the limited scope of modern electronic health records (EHRs) (5–7).

Patients admitted to the ICU often have critical illness potentiated by SRFs, most commonly due to sepsis, but the extent to which critical illness can be attributed to SRFs has not yet been satisfactorily demonstrated (8, 9). Since

DOI: 10.1097/CCE.0000000000000761

the burden of SRFs falls inequitable upon Blacks in the United States, many studies have explored whether racial disparities exist in the ICU (10). However, associations between race and mortality were strongly attenuated by socioeconomic status (SES), insinuating that race alone cannot fully capture the complex relationship between SDOH and health outcomes (11). Although SES may more accurately reflect the distribution of SRFs, most literature in critical care medicine represent SES using abstracted indexes from census data (12–16). Problematically, this assumes that all residents of a neighborhood share the same SRFs and reinforces the stereotype that only low-income families experience SRFs (17).

Rather than approximating SRFs from basic sociodemographic data or SES, we implemented a screening program to directly discuss multiple domains of SDOH with our patients. The pertinence of our goal became more apparent in the wake of the social impact inflicted by the COVID-19 pandemic. Economic hardships, often brought by loss of employment, left families struggling to pay for rent and food (18). Certain communities, in color or creed, were disproportionally affected by the virus from reasons including the inability to enforce physical distancing and a greater burden of comorbidities (19). Patients in these communities were more likely to become hospitalized because of COVID-19 and later admitted to the ICU or die (20, 21). Given the role the ICU serves in treating the most severe cases of community-acquired illnesses, changes in the proportions of patients with SRFs could reflect reverberations from catastrophes and policies at the national and local level.

Importantly, we sought to determine the feasibility and utility of eliciting SRFs from critically ill patients. The primary objectives of this single-center prospective observational cohort study were to: 1) quantify the prevalence of SRFs in the ICU, 2) determine what characteristics are associated with SRFs, and 3) contextualize our findings regarding policy responses to COVID-19.

METHODS

Study Design, Setting, and Participants

From July 1, 2019, to September 30, 2021, all patients admitted to the medical ICU at Robert Wood Johnson University Hospital were eligible for this prospective observational cohort study. The Institutional Review Board of Rutgers Biomedical and Health Sciences waived approval for this study, titled the Integrative Multisector Partnership to Address Patient's Social and Health Needs (Pro2019002909), on January 16, 2020. However, due to the sensitive nature of SRFs, we still asked for consent before initiating screening with each patient. We adhered to the ethical standards of the Institutional Review Board and the Helsinki Declaration of 1975.

For incapacitated patients, our team interviewed visiting family members. Because our study intended to connect New Jersey (NJ) residents to local resources, we only included patients with addresses within NJ. Finally, screening was only conducted when a social worker was available, excluding patients who were only available for screening at night or during the weekend.

Our study includes patients treated prior to and during the pandemic. We marked the onset of the pandemic as March 31, 2020, when our ICU received an influx of COVID-19 related admissions. Due to our unit discouraging extended contact with patients during this time, we temporarily halted data collection from March 31, 2020, to June 30, 2020.

Participants were asked questions based off an adapted version of the American Academy of Family Physicians' Social Needs Screening Tool borrowed from our healthcare system's family-oriented community clinic, the Eric B. Chandler Health Center (**Table 1**). This screening tool was selected to capitalize on existing partnerships with community organizations that offered support for disadvantaged patients. Multiple domains of SDOH were covered by the screening tool: food, housing, utilities, medication, transportation, access to healthcare, and caregiver support.

To successfully incorporate screening into the ICU workflow, we embedded the screening tool into our EHR with the support of IT staff and administration. Prior to engagement, we held teaching sessions to promote teamwork and reduce communication errors between residents, nurses, pharmacists, social workers, case managers, and students. Following a script, an attending physician, critical care fellow, or nurse interviewed each patient and provided the opportunity to consult with social services. For patients who did not prefer to use English during the clinical interaction, we consulted interpreters through LanguageLine Solutions.

TABLE 1.
Screening Tool for Social Risk Factors

Social Risk Factor	Screening Question	Prevalence, *n* (%)
Food insecurity	In the last 12 mo, did you ever eat less than you felt you should because there was not enough money for food?	47 (8.30)
Utility debt	In the last 12 mo did you have trouble paying your utility bills?	42 (7.42)
Housing instability	Are you worried that you may lose your housing or be evicted on the next 2 mo?	63 (11.13)
Cost-related nonadherence	In the last 12 mo, have you had difficulty purchasing or taking medications as prescribed by a doctor?	52 (9.19)
Transportation limitation	In the last 12 mo, have you missed a doctor or medical appointment because of a transportation-related issue?	66 (11.66)
Inadequate caregiver support	Do you have childcare or caregiver issues/concerns that make it difficult for you to work or study?	91 (16.08)
Inability to afford healthcare	In the last 12 mo, have you missed a doctor or medical appointment because of cost?	89 (15.72)

Each social risk factor assessed by our screening tool is shown along with its corresponding screening question and prevalence within our cohort.

Data Sources

Sociodemographic data (age, race, gender, and insurance type) were extracted from EHR. Racial identity was often assumed rather than solicited, limiting our ability to make detailed comparisons across race and ethnicity. Unfortunately, this is a pervasive aspect of studies like ours that rely on staff observations instead of self-report for determining racial identity (22). As such, we used a dichotomous race measure, denoting if a person was Black or African American. Public data from the U.S. Census Bureau's American Community Study were used to match zip codes with median income per household (ZMHI). ZMHI was divided into four quartiles with Q1 representing the poorest areas serviced by our healthcare system. To describe the clinical presentation of each patient, we used the Acute Physiology and Chronic Health Evaluation III scoring system for its superior discriminatory ability (23, 24). Dichotomous variables were created to indicate which SRFs were endorsed by individuals.

Statistical Methods

Univariate statistics including frequency (%) and median (interquartile range) were calculated for all variables; normality was assessed using Shapiro-Wilks test ($p < 0.05$). Comparisons were performed using chi-squared tests for categorical data and Wilcoxon rank sum tests for continuous data. Pearson correlation matrices were used to evaluate relationships between SRFs. To determine shifts in the prevalence of SRFs prior to and during the pandemic, we compared the proportion of patients in each period who screened positively for SRFs. All analyses were performed in R Studio (4.0.3; RStudio Team: RStudio: Integrated Development for R. *RStudio* 2020) and used two-tailed tests with an alpha of 0.05. To note, our results differ from an earlier analysis published in an abstract due to refinement of our exclusion criteria and timepoint definition (25).

RESULTS

Participants

Out of 1,319 ICU admissions, 566 NJ residents (42.91%) underwent screening during our study period (**Fig. 1**). For 211 patients (37.28%), family members or an identified proxy answered questions regarding SRFs on their behalf. Most of those screened arrived after the onset of the pandemic (443; 78.27%), and a sizable minority reported at least one SRF (224; 39.58%). Table 1 displays the seven SRFs elicited by our screening tool along with the corresponding questions. The percentage of patients attributed to each SRF was lowest for utility debt (42; 7.42%) and highest for inadequate caregiver support (91; 16.08%).

Main Results

In **Figure 2**, per each SRF, we highlight demographic and clinical differences between patients with and without the SRFs. For reference, the characteristics of

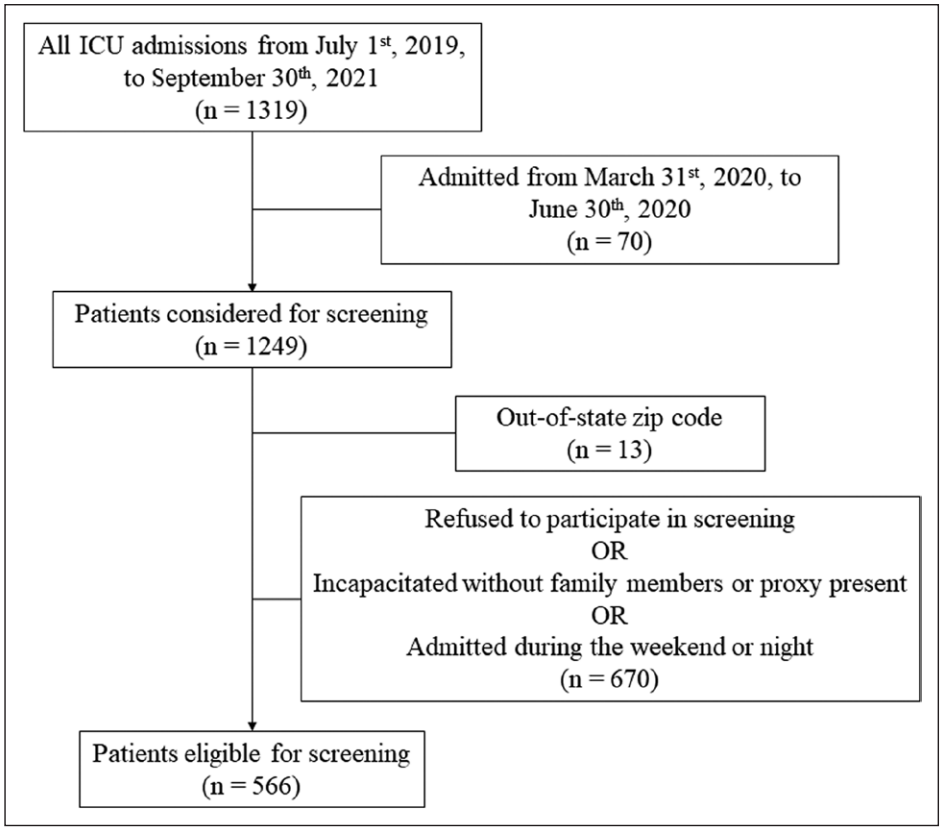

Figure 1. Consort diagram. This figure depicts how many patients out of those admitted to the medical ICU at Robert Wood Johnson University Hospital from July 1, 2019, to September 30, 2021, were eligible for our study.

those without any SRFs are shown. Patients who reported SRFs were, on average, younger except for those with the inability to afford healthcare and were statistically significantly older (Fig. 2*A*). Except for patients reporting inadequate caregiver support, those with SRFs were disproportionally represented in the poorest two ZMHI quartiles (Fig. 2*B*) and were more inclined to use Medicaid or out-of-pocket sources of healthcare coverage (Fig. 2*C*). The median severity score was lower for patients with SRFs compared with those without (Fig. 2*D*). Gender did not statistically significantly differ between patients with or without SRFs. The proportion of Black patients only diverged in one domain of SDOH, healthcare access, in which it was considerably lower (5.62% vs 15.51%). Conversely, the percentage of White patients with the inability to afford healthcare was disproportionally high (70.79% vs 61.01%).

Correlation Matrix

SRFs were weakly to moderately intercorrelated (**Fig. 3**). Food insecurity, utility debt, housing instability, cost-related nonadherence, and transportation limitation were positively interrelated with strengths ranging from 0.27 to 0.57. Inability to afford healthcare was not related to three other SRFs, and inadequate caregiver support was weakly correlated with other SRFs except for transportation limitation ($r < 0.20$). Patients with SRFs trended toward reporting either inadequate caregiver support, inability to afford healthcare, or a combination of the remaining SRFs targeted by our screening program.

Prevalence of SRFs Before and During the Pandemic

Access to or demand for critical care services by those with SRFs changed since the onset of the pandemic, as shown in **Figure 4**. The prevalence of SRFs in our ICU overall fell from 54.47% to 35.44% and decreased across all categories except for inability to afford healthcare, which increased statistically significantly from 7.32% to 18.06%.

DISCUSSION

Relying on primary care services to screen for SRFs assumes access to healthcare, which alienates those who may benefit the most from being connected to social services. Discussing SDOH with critically ill patients and their families defined norms on both sides of the clinical interaction. As such, our study required months of preparation to embed a screening tool into our EHR and educate all members of our clinical team. However, by contextualizing ICU admissions with SRFs, we enabled our healthcare system and community partners to respond accordingly. Our study is novel for: 1) introducing a screening program for multiple SRFs into the ICU and 2) exploring the characteristics and prevalence of critically ill patients with SRFs during an ongoing pandemic.

The fallout from the COVID-19 pandemic demonstrates how the ICU can function as a barometer of social change. From March to April, 2020, NJ witnessed a record of high unemployment rate and unprecedented

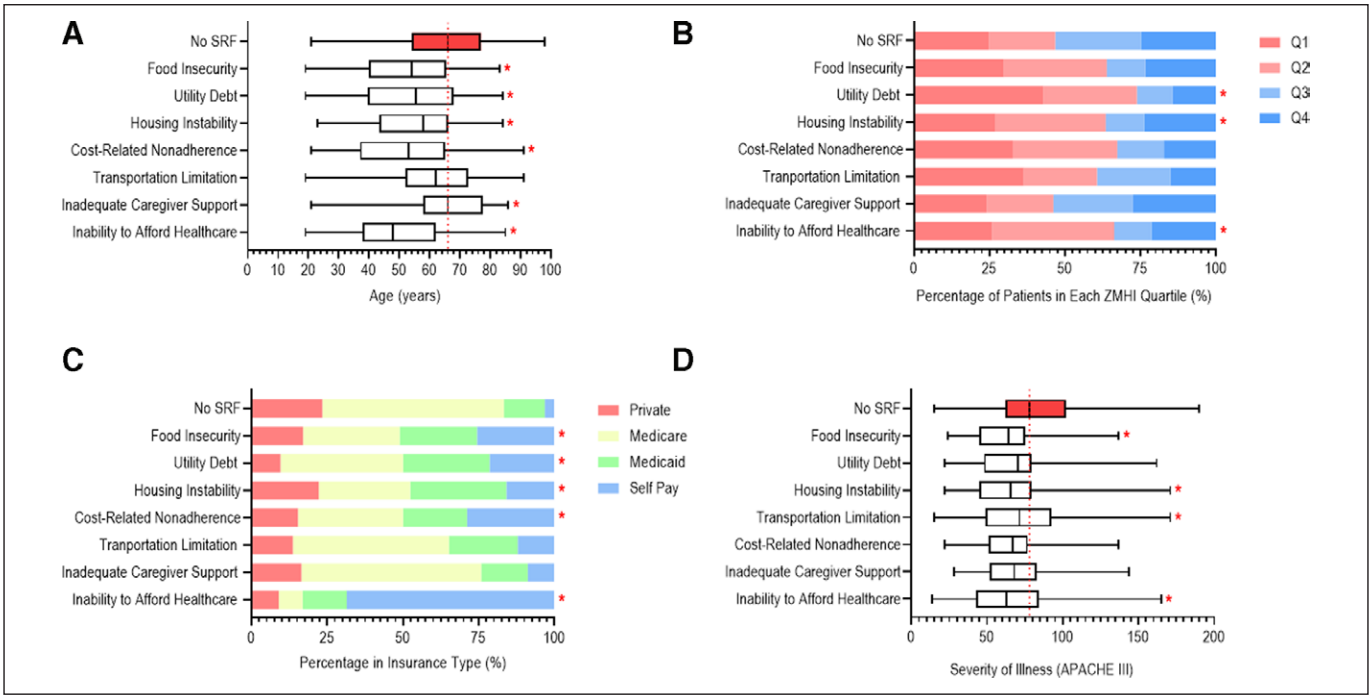

Figure 2. Characteristics of patients with social risk factors (SRFs). For each social risk factor, between patients with versus without the social risk factor, we compared age (**A**) and severity of illness by Wilcoxon rank sum tests (**D**) and proportion of patients within each socioeconomic quartile (**B**) and insurance type (**C**) by chi-square tests. Significant results determined by a *p* value of less than 0.05 are indicated by a *red asterisk*. For continuous variables, a box plot demarcated with median, interquartile range, and range is shown with a *red line* indicating the median values of patients without any social risk factors as a reference. For categorical variables, a bar graph with colors corresponding to each category is used. APACHE III = Acute Physiology and Chronic Health Evaluation III, ZMHI = zip-code matched median household income.

numbers of unemployment insurance claims, leading to large losses in employer-based health coverage (26). During the same time, the NJ Department of Health released triage guidelines prioritizing younger patients with lower severity scores (27). These conditions may have produced an overwhelming amount of newly uninsured patients who were prioritized for ICU admission given their favorable prognosis, producing a shift in our patient population. Due to the hospital regulations enforcing minimal patient interactions that required us to halt screening from March to June, 2020, our study potentially underestimated the extent of this surge in demand for critical care services by patients unable to afford healthcare. Meanwhile, the overall prevalence of SRFs reported by critically ill patients fell by about 20% since the pandemic. Optimistically, this may reflect the work of organizations, energized by investments from the NJ Pandemic Relief Fund and American Rescue Plan, that launched programs for food distribution, legal aid enforcing rent moratoriums, and assistance with affording medications (28, 29). Conversely, this trend could indicate exacerbated inequity in healthcare access. During shortages in ICU bed supply, Kanter et al (30) identified a large gap in access by income, despite COVID-19 disparately harming low-income households who were more likely to report SRFs (31). By studying SRFs in an ICU setting, we continue the narrative that allocation criteria failed to prioritize distributing vaccines and critical care services to disadvantaged individuals and groups (32).

Notably, critically ill patients with SRFs in our cohort were disproportionally assigned a low severity score upon admission. Although the dearth of studies on SRFs in the ICU prevents a conclusive explanation, this finding may be an artifact of a distinct disease burden or comorbid load. SRFs may contribute to acute in healthier individuals rather than exacerbations of chronic conditions (33, 34). Interestingly, Bein et al (35) concluded that critically ill patients with a low SES, as determined by a questionnaire, had increased risk of a high severity score. We attribute our contradictory findings to our decision to conduct our study in the medical ICU, which receives patients with community-acquired disease rather than surgical complications. Furthermore, we directly elicited SRFs instead of making assumptions by SES. Although healthier patients

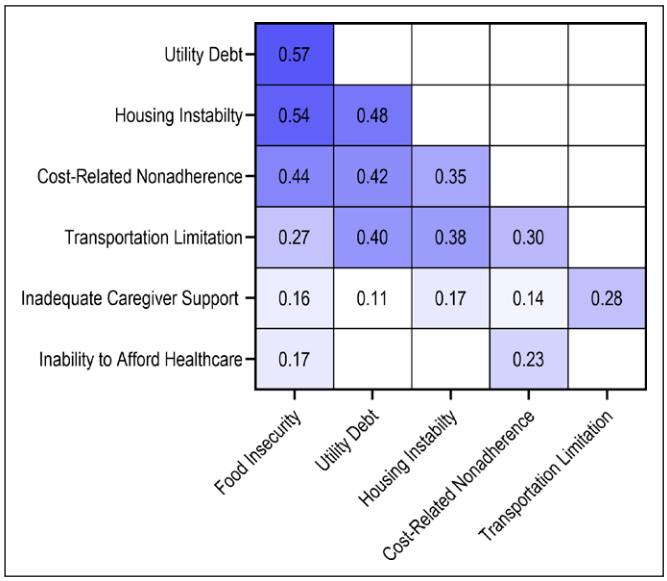

Figure 3. Correlation matrix of social risk factors. This correlation matrix demonstrates the extent to which each social risk factors was reported together. Each Pearson correlation coefficient with a *p* value of less than 0.05 was determined to be statistically significant and included in the figure. The shade of *blue* corresponds to the strength of the correlation which was defined as weak ($r < 0.20$) or moderate ($0.20 < r < 0.60$).

require fewer diagnostic tests and equipment, these patients still accumulate high levels of fixed overhead costs that constitute the bulk of ICU spending (36, 37). Critical care medicine accounts for 13.21% of total hospital care expenditure as costs per day in the ICU equal six to seven times those in a general ward (38, 39). Many institutions have concluded that treating low-risk patients in the ICU is not cost-effective, instead opting for an intermediate or step-down unit (40, 41). Thus for healthcare systems, there exists a financial imperative to address SRFs that discourages proper health management, ultimately leading to possibly preventable ICU admissions.

In an era of precision medicine and growing recognition of SDOH, the contemporary clinical workflow in the ICU should include a standardized process to detect SRFs. Our study demonstrates that SRF should not be assumed from of basic sociodemographic data and SES. For example, inadequate caregiver support predominately affected elders who may have multiple chronic conditions that can be exacerbated without proper monitoring and support (42). However, exposure to this SRF did not change based on race, SES, or insurance type. On the other hand, those with the inability to afford healthcare were disproportionately younger, poorer, and uninsured. Additionally, we found that most patients with the inability to afford healthcare were White; however, we hypothesize this number could include many Hispanics, who represent a growing share of the uninsured within the United States (43, 44). A screening program can help identify subgroups within a heterogeneous critically ill patient population who are especially vulnerable to certain SRFs. We found that certain SRFs—but not all—shared modest correlations and were often reported together. This implies that policy addressing SRFs should carefully consider the domains of SDOH relevant to the target population (46).

As a single-center investigation, immediate generalization of the presented findings to other institutions has not yet been validated. However, we share the results of our study to encourage other ICUs to identify SRFs in their patient population. Notably, due to selection bias, our study potentially underestimated the extent of SRFs by 1) only being able to screen incapacitated patients if family was present and 2) temporarily halting screening when quarantining policies discouraged extensive face-to-face communication. Further, our definition of racial and ethnic identity is limited due to incomplete data collection, especially because our failure to qualify Hispanic versus non-Hispanic. However, this reflects oversight by our healthcare system and others (47). That race and ethnicity are assumed by the admitting clerk in most hospitals calls into question the validity of conclusions based on EHR data on race alone (22). Finally, as our study was centered on introducing the practice of screening for SRFs into the ICU, we limited the scope to univariate analysis. Future studies can seek to determine whether SRFs has an independent effect on health outcomes, including mortality and readmission, through multivariate regression models.

CONCLUSIONS

Neglecting to acknowledge SDOH in the ICU may perpetuate ignorance of SRFs that predispose disadvantaged patients toward developing low-risk severe illnesses, incurring high medical costs, and requiring critical care services. In our prospective observational cohort study, we successfully introduced a standardized procedure for discussing SDOH in our ICU workflow by implementing a screening program at our medical ICU endorsed by administration, information technology staff, and our clinical team. Importantly, we found that although nearly four in 10 critically ill patients reported at least one SRF, the overall prevalence of SRFs changed from structural forces set in motion by the COVID-19 pandemic.

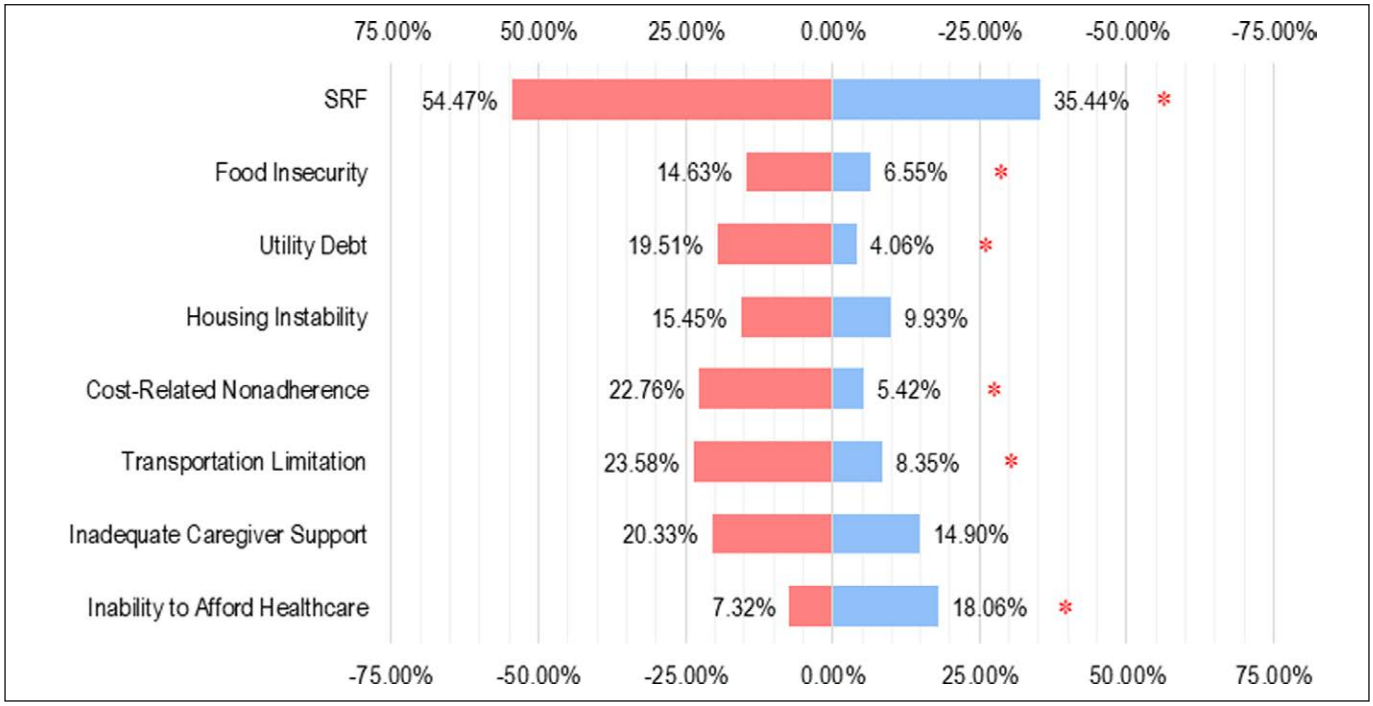

Figure 4. Prevalence of social risk factors (SRFs) before and during the pandemic. Among all those screened in our study, the prevalence of social risk factors before and during the COVID-19 pandemic are shown together and independently. We compared differences in the proportion of patients with each SRF between these two time periods with chi-square tests. Statistically significant differences, defined as a *p* value of less than 0.05, are denoted with a *red asterisk*.

ACKNOWLEDGMENTS

We would like to thank Dr. Robert Like and Maria Pellerano (Robert Wood Johnson Medical School, Rutgers University) for inspiring and supporting this project.

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The authors have disclosed that they do not have any potential conflicts of interest.

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