
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

# Heart Failure Hospitalizations and Risk Factors among the Multi-Ethnic Population from a Middle Income Country: The Suriname Heart Failure Studies

Shellice Sairras, M.Sc., Se-Sergio Baldew, P.T., Ph.D., Kwame van der Hilst, M.D., Arti Shankar, Ph.D., Wilco Zijlmans, M.D., Ph.D., Maureen Lichtveld, M.D., M.P.H., Keith Ferdinand, M.D., Ph.D.

*Abstract: Introduction:* Heart failure (HF) is an emerging epidemic with poor disease outcomes and differences in its prevalence, etiology and management between and within world regions. Hypertension (HT) and ischemic heart disease (IHD) are the leading causes of HF. In Suriname, South-America, data on HF burden are lacking. The aim of this Suriname Heart Failure I (SUHF–I) study, is to assess baseline characteristics of HF admitted patients in order to set up the prospective interventional SUHF-II study to longitudinally determine the effectiveness of a comprehensive HF management program in HF patients.

*Methods:* A cross-sectional analysis was conducted of Thorax Center Paramaribo (TCP) discharge data from January 2013-December 2015. The analysis included all admissions with primary or secondary discharge of HF ICD-10 codes I50-I50.9 and I11.0 and the following variables: patient demographics (age, sex, and ethnicity), # of readmissions, risk factors (RF) for HF: HT, diabetes mellitus (DM), smoking, and left ventricle (LV) function. T-tests were used to analyze continuous variables and Chi-square test for categorical variables. Differences were considered statistically significant when a p-value $<0.05$ is obtained.

*Results:* 895 patients (1:1 sex ratio) with either a primary (80%) or secondary HF diagnosis were admitted. Female patients were significantly older ($66.2 \pm 14.8$ years, $p < 0.01$) at first admission compared to male patients ($63.5 \pm 13.7$ years) and the majority of admissions were of Hindustani and Creole descent. HT, DM and smoking were highly prevalent respectively 62.6%, 38.9 and 17.3%. There were 379 readmissions (29.1%) and 7% of all admissions were readmissions within 30 days and 16% were readmissions for 31-365 day. IHD is more prevalent in patients from Asian descendant (52.2%) compared to African descendant (11.7%). Whereas, HT (39.3%) is more prevalent in African descendants compared to Asian descendants (12.7%). There were no statistically significant differences in age, sex, ethnicity, LV function and RFs between single admitted and readmitted patients.

*Conclusion:* RF prevalence, ethnic differences and readmission rates in Surinamese HF patients are in line with reports from other Caribbean and Latin American countries. These results are the basis for the SUHF-II study which will aid in identifying the country specific and clinical factors for the successful development of a multidisciplinary HF management program.

**Keywords**: Heart failure■Hospitalizations■Chronic disease management model■Low and middle income countries■Suriname

**Author affiliations:** Shellice Sairras, Scientific Research Center Suriname (SRCS), Academic Hospital Paramaribo (AZP), Suriname; Se-Sergio Baldew, Physical Therapy Department, Faculty of Medical Sciences, Anton de Kom University of Suriname, Paramaribo, Suriname; Kwame van der Hilst, Thorax Center Paramaribo, Academic Hospital Paramaribo, Suriname; Faculty of Medical Sciences, Anton de Kom University of Suriname, Paramaribo, Suriname; Arti Shankar, Department of Biostatistics, Tulane University School of Public Health and Tropical Medicine, New Orleans, LA, USA; Wilco Zijlmans, Faculty of Medical Sciences, Anton de Kom University of Suriname, Paramaribo, Suriname; Department of Global Environmental Health Sciences, Tulane University, New Orleans, LA, USA; Maureen Lichtveld, Department of Global Environmental Health Sciences, Tulane University, New Orleans, LA, USA; Keith Ferdinand, John W. Deming Department of Medicine, Tulane University School of Medicine, New Orleans, LA, USA

Correspondence: Shellice Sairras, M.Sc., Academic Hospital Paramaribo, Picorni Street 11, Paramaribo, Suriname. Fax: (597)499224., email: ssairras@azp.sr

© 2020 by the National Medical Association. Published by Elsevier Inc. All rights reserved.

https://doi.org/10.1016/j.jnma.2020.08.010

## INTRODUCTION

### Background

Heart failure (HF) is an emerging epidemic with more than 26 million patients worldwide and is steadily increasing in prevalence and costs, primarily due to increased prevalence of hypertension (HT), along with other HF risk factors, such as diabetes mellitus (DM), aging populations, and the successful rate of acute cardiovascular disease (CVD) treatments.[1,2] HF is one of the leading causes of (re)hospitalizations in elderly people but is listed as a preventable hospitalization condition.[3] There is great variation between different world regions and countries in HF prevalence, care, and etiologies.[4-6] For instance, in the United States (U.S.) and the United Kingdom (UK) black people have a higher HF prevalence rate, less access to advanced healthcare, and poorer HF outcomes compared to white people.[7-9] In addition, HF studies in Afro-Caribbeans show that the risk of HF in that population aged 60-79 years is as much as 3.1 higher than in Caucasians, and that HT is the main cause of HF in the Afro-Caribbean population.[10,11] Various authors have suggested that the role social determinants of health, such as environment, lifestyle, access to care as well as comorbidities, play in the outcomes between different ethnicities must be taken into account.[11-14]

HT is highly associated with HF in all regions, but most commonly in Latin America, the Caribbean, Eastern Europe, and sub-Saharan Africa, and with a minimal association of ischemic heart disease (IHD) in sub-Saharan Africa.[15,16] Great effort globally has been put into

understanding and treatment strategies for HF. There have been improvements in mortality rates, quality of life and reductions in HF exacerbations in some populations.[9,17] Primarily, HF care has improved in high Income countries (HIC), with extensive healthcare resources including dietary interventions, exercise and cardiac rehabilitation programs. However, even in HIC, there are healthcare delivery discrepancies resulting in often intransigent health disparities, and progress is lacking in promoting healthy lifestyles and medication adherence.[8] A recent state-of-the art review has shown multiple factors affect adherence in CVD patients, including socio-economic factors (illiteracy, cultural and lay beliefs about illness and treatment, etc.), healthcare system factors (provider-patient relationship, limited system capacity for patient education and follow-up), and other patient related factors.[18] Despite the presence of these differences, there is limited information on patients' sociodemographics, etiology, physician and patient knowledge, and the management of HF in underrepresented regions such as the multiethnic Latin and Caribbean (LAC) region. Data and information generated from HF research in these vulnerable sub-populations will inform region specific evidence-based practice guidelines and guide effective health policies.

### Suriname

The Republic of Suriname is an upper middle income country on the north east coast of South-America and part of the Caribbean Community (CARICOM) and has 541,638 inhabitants. The country can be divided into an urban coastal, rural coastal and rural tropical rainforest interior area.[19] The population is multiethnic and multicultural, with mainly people from African: Creole (15.7%, African descendants whom mainly remained in the city after slavery) and Tribal communities (21.7%, African descendants whom mainly remained in the rural areas of Suriname after slavery), and Asian: Hindustani (27.4%, descendants from India), Javanese (13.7%, descendants from Java) and Chinese (Chinese recently arriving from China or Chinese descendants after the Surinamese immigration period from China) descent residing mostly in the coastal area, including the capital Paramaribo.[20] The age adjusted total death rate in Suriname has been declining in recent years, however it is still higher (726.8-656.9 per 10.000 total deaths between 2005 and 2014) compared to the U.S. (518.2-474.3 per 10.000 total deaths between 2005 and 2014). This is also the case for the age adjusted heart disease mortality rate in Suriname (261.7-197.6 between 2005 and 2014 per 10.000 total deaths) compared to the U.S (163.3-131.6 in 2014 per 10.000 total deaths).[21] CVD is the major cause of death (28%) and several studies on CVD risk factors prevalence in Suriname, have shown a high and rising prevalence of these risk factors.[22-27] The Suriname Health Study, for instance, demonstrated a prevalence of 26% for HT, 14% for DM and approximately 30% of people between 55 and 64 years of age with three or more CVD risk factors.[28,29] This high prevalence of risk factors may result in a high CVD and HF burden. In addition, HF is the leading cause of preventable hospitalizations in people older than 19 years, with 38 HF hospitalizations per 10.000 inhabitants per year taking place.[30] Actual data of HF prevalence, etiology and risk factors are lacking in Suriname, therefore hindering an adequate assessment of the actual HF burden. Management of HF may not be adequately addressed and HF-specific public health policy and management may be poorly developed.

Currently, the Thorax Center Paramaribo (TCP), the reference center for cardiac care in Suriname, is developing a comprehensive HF program to improve the delivery of healthcare to HF patients and improve their quality of life with the aim to reduce HF re (hospitalizations). The purpose of the Suriname HF−I study (SUHF−I) is to retrospectively describe the demographic characteristics of hospitalized HF patients in the TCP. SUHF−I will serve as baseline for a prospective HF epidemiologic study, SUHF-II, aimed at informing future interventions to improve the HF healthcare delivery and reduce the HF burden in Suriname.

## METHODS

### Study design and site

The SUHF−I study is single center hospital based study conducted at the TCP in the Academic Hospital Paramaribo (AZP). The AZP is the largest hospital in Suriname with 530 beds and 26.000 annual admissions, situated in the capital Paramaribo. The reference TCP-AZP delivers interventional cardiac care with 34 beds and 2500 annual admissions and provides care for the majority of CVD patients. According to the 'Avoidable hospitalizations in Suriname study', 80% of HF admissions were in the TCP-AZP and therefore represents a national estimate to the study on avoidable hospitalizations in Suriname.[30]

### Data collection

We included all HF hospitalizations in the TCP-AZP with a primary or secondary discharge diagnosis of HF between January 1, 2013 and December 31, 2015. The included hospitalized patients were diagnosed with HF by the treating medical specialists in accordance with the international HF guidelines.[17,31] and using the following International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes: I11.0 and I50.0-I50.9. Patient discharge data were retrieved from the electronic database, KISS database (v3.50, Kootstar software), of the TCP and include patient demographics (age, sex, and ethnicity), unique debt or

**Table 1.** Characteristics of HF hospitalized patients (index admission) in the TCP-AZP 2013-2015.

| | All | Male | Female | p-value |
|---|---|---|---|---|
| Hospitalizations | | | | |
| # of hospitalizations in the AZP >18 yrs | 61,417 | 25,569 | 35,848 | |
| # Of HF admissions, N (%) | 1,274 (2.0) | 649 (2.5) | 625 (1.7) | |
| # of patients | 895 (70.2) | 462 (51.6) | 433 (48.4) | |
| Average age (SD) | 64.8 (14.2) | 63.5 (13.7) | 66.2 (14.8) | 0.005 |
| Type of admission, N (%) | | | | 0.806 |
| Primary HF admission | 735 (82.1) | 378 (81.8) | 357 (82.4) | |
| Secondary HF admission | 160 (17.9) | 84 (18.2)) | 76 (17.6) | |
| In hospital mortality, N (%) | 37 (4.1) | 18 (3.9) | 19 (4.4) | 0.712 |
| Length of stay, days | | | | |
| Average (SD) | 7.3 (7.1) | 8.3 (6.8) | 8.3 (7.6) | 0.962 |
| Ethnicity, N (%) | | | | 0.675 |
| Chinese | 7 (0.8) | 3 (0.6) | 4 (0.9) | |
| Creole | 216 (24.1) | 111 (24.0) | 105 (24.2) | |
| Hindustani | 337 (37.7) | 161 (34.8) | 176 (40.6) | |
| Indigenous | 15 (1.7) | 9 (1.9) | 6 (1.4) | |
| Javanese | 97 (10.8) | 55 (11.9) | 42 (9.7) | |
| Mixed | 103 (11.5) | 56 (12.1) | 47 (10.9) | |
| Others | 27 (3.0) | 15 (3.4) | 13 (3.1) | |
| Tribal communities | 92 (10.3) | 52 (11.3) | 40 (9.2) | |
| Risk factors, N (%) | | | | |
| HT | 650 (62.6) | 322 (69.7) | 328 (75.8) | 0.042 |
| DM | 348 (38.9) | 162 (35.1) | 186 (43.0) | 0.016 |
| Hyperlipidemia | 45 (5.0) | 24 (5.2) | 21 (4.8) | 0.813 |
| Smoking | 155 (17.3) | 122 (26.4) | 33 (7.6) | 0.000 |
| ≥2 RFs | 386 (43.1) | 197 (51.0) | 189 (49.0) | 0.761 |
| Left ventricle function | | | | 0.000 |
| LVrEF (EF ≤ 40%) | 339 (42.2) | 211 (50.1) | 128 (33.4) | |
| LVpEF (EF>40%) | 465 (57.8) | 210 (49.9) | 255 (66.6) | |
| Medical therapy at discharge | | | | |
| beta-blockers | 301 (33.6) | 133 (28.8) | 168 (38.8) | 0.002 |
| Loop diuretics | 700 (78.2) | 376 (81.4) | 324 (74.8) | 0.018 |
| ACE/ARBs inhibitors | 646 (72.2) | 342 (74.0) | 304 (70.2) | 0.203 |
| Statins | 347 (38.8) | 192 (41.6) | 155 (35.8) | 0.077 |
| DM medication | 232 (25.9) | 102 (22.0) | 130 (30.0) | 0.007 |
| Digoxin | 119 (13.3) | 66 (14.3) | 53 (12.2) | 0.368 |
| Anti-coagulation | 526 (58.8) | 277 (60.0) | 249 (57.5) | 0.457 |
| Nitrates | 282 (31.5) | 149 (32.3) | 133 (30.7) | 0.621 |
| CVD Readmissions, N (%) | | | | |
| # Readmissions | 379 (29.7) | 187 (28.8) | 192 (30.7) | 0.457 |

*continued…*

*continued…*

| | All | Male | Female | p-value |
|---|---|---|---|---|
| # readmitted patients | 219 (24.5) | 115 (52.5) | 104 (47.5) | 0.626 |
| ≤30 days | 64 (7.1) | 35 (7.4) | 29 (6.9) | |
| 1 year | 145 (16.3) | 74 (16.0) | 71 (16.4) | |

*HT, Hypertension; DM, Diabetes Mellitus; RFs, Risk Factors; LVrEF, left ventricle with reduced ejection fraction; LVpEF, left ventricle with preserved ejection fraction; SD, standard deviation; ACE/ARBs inhibitors, angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker; DM medication, pharmacological treatments for the management of diabetes mellitus.*

*All presented variables are calculated using the index (single and first) hospitalization except when calculating CVD readmissions.*

*Percentages per category are calculated using the N of the variable divided by the N of the patient sex group (462 for men and 433 for women) except when calculating the readmission rates (the number of HF hospitalizations is used).*

number (used to determine number of hospitalizations/admissions per patient), length of stay (LOS), primary and secondary discharge diagnosis, HF etiology, status after discharge, and HF risk factors (HT, DM, hyperlipidemia and smoking). All comorbidities were diagnosed by the managing medical specialist, according to international guidelines, or already known as a diagnoses during admission of the patient. Ethnicity was self-reported.

### Study outcomes

The primary study outcomes were patient demographics (sex and age), etiology, 30-day and 1-year HF hospital readmission, and left ventricile (LV) function. The admission was a primary HF admission if the HF ICD-10 code was listed on the first position in the discharge report, and otherwise, it was a secondary HF admission. The first admission for each patient is the index admission and subsequent admissions are grouped into either 30 day readmission (readmitted within 30 days after discharge) or 1 year (30 days $>$ readmitted $>$ 1 year). The LV function was determined using the calculated ejection fraction (EF), the wall motion score index (WMSI) and the conclusion of the cardiologist of the patient's LV function based on echocardiographic measurements and divided into reduced ventricle function (LVrEF$\leq$40%) and preserved ventricle function (LVpEF $>$40%).

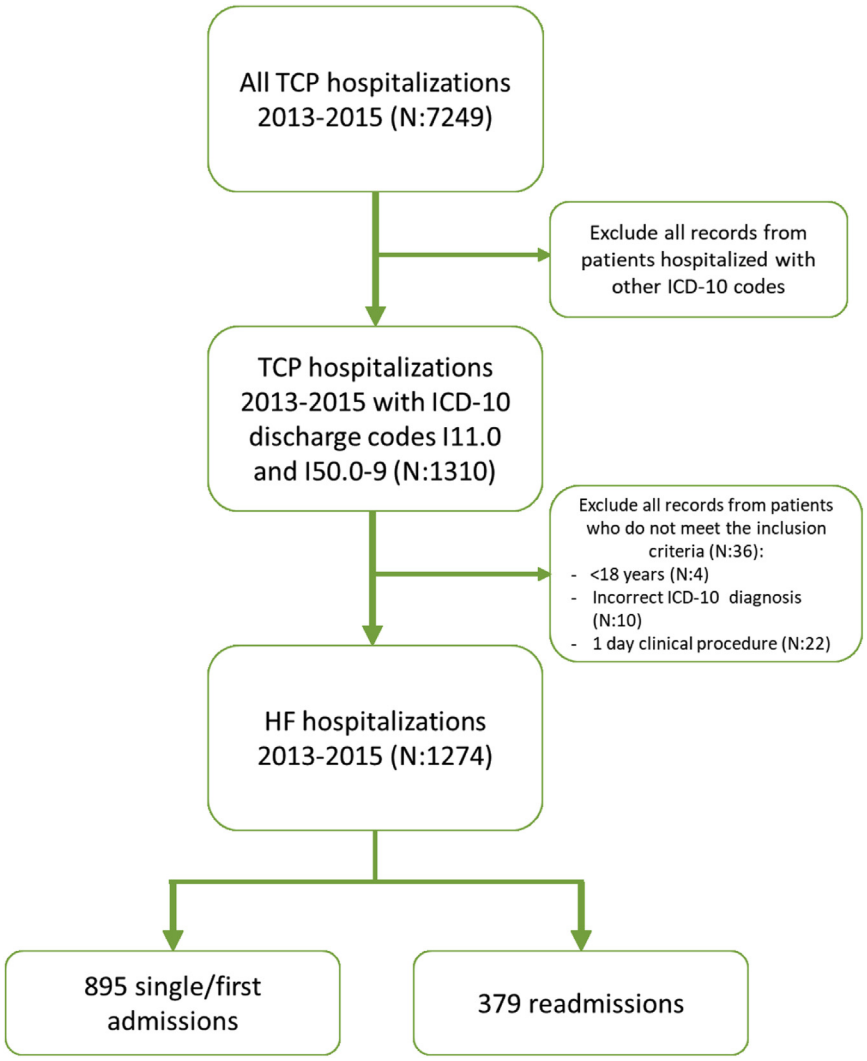
**Data analysis.** Data analysis was done using Statistical Package for the Social Sciences (SPSS) version 23 (IBM, Chicago, USA). Continuous variables are presented as mean with standard deviation (SD) (parametric analysis) or median (range) (non-parametric analysis). Student's T-test was used for testing statistical significance for the variables age and length of stay (LOS). Categorical variables (all other variables in Table 1) are presented as frequencies (N, percentages) and were analyzed for statistical significance using the chi-square test. Differences were considered statistically significant when a p-value $<0.05$ is obtained. All analyses have been conducted using the index admission, unless otherwise stated.

## RESULTS

### Demographics

Between 2013 and 2015 there were 1310 HF registered admissions within the TCP and after thorough screening on our inclusion criteria 1274 admissions from 895 HF patients were included in our analysis (Figure 1). Table 1 presents the demographic characteristics for the first/single admission distributed between male and female patients. The 1274 admissions are approximately 2% of total AZP admissions and more than 80% of admissions were for a primary HF hospitalization with a median length of stay of 7 days and an in-hospital mortality of 4.1%. Female patients were significantly older (66.2 $\pm$ 14.8 years, $p < 0.01$) at first admission compared to male patients (63.5 $\pm$ 13.7 years). Patients from Asian descent had the most frequent hospitalizations, followed by patients from African descent. The risk factors HT, DM and smoking were highly prevalent among the patients respectively 62.6%, 38.9 and 17.3%, with statistically significant sex differences for DM ($p = 0.01$) and smoking ($p < 0.01$). Also, approximately 43% of admitted patients had 2 or more of these risk factors. There was a statistically significant difference between female patients and male patients admitted with preserved ventricle function (66.6%, $p < 0.01$) and (33.4%), respectively. Prescribed medical therapy at discharge follows the guideline-directed medical therapy (GDMT); however, further analysis based the patient's condition is needed to fully determine the GDMT adherence. Approximately 30% of all admissions were readmissions, 7% of all admissions were readmissions within 30 days and about 16% were readmissions after 30

**Figure 1.** HF hospitalizations and patient flowchart.




days but within 1 year. To determine which demographic factors may influence readmission, we compared the index admission of single admitted versus readmitted patients (Table 2). We do not see any significant differences in age, sex, ethnicity, and risk factors between single admitted and readmitted patients. The LV function shows borderline significance with a higher percentage of LVpEF for single admitted patients compared to patients with more admissions (see Figure 2).

## *Etiology*

The top 5 etiologies of HF were IHD, hypertensive heart disease (HHD), valve diseases, tachyarrhythmias, and dilated cardiomyopathies with 34.3%, 24.1%, 13.1%, 8.9%, and 8.1% respectively (Fig. 2). Stratified to ethnicity, IHD was the cause for HF among 52.2% of Asian descent patients and among 11.7% of African descent patients, whereas HHD was the cause of HF among 39.3% of African descent patients compared to 12.7% of Asian descent.

## *Discussion*

To our knowledge, this is the first study to explore HF in an acute setting in Suriname. Our results show that 2% of all hospitalizations in the AZP were due to HF and that relatively more men were admitted than women. The average age was 64 years, and women were significantly older than men at the index admission and the Hindustani and Creole were most frequently admitted. Ischemic Heart Disease and HHD were primary causes for HF and there were clear differences in etiology between ethnic groups.

Our admission age (64 yrs) is relatively lower compared to high income countries such as the U.S. (73

**Table 2.** Characteristics of HF hospitalized patients divided in single admitted patients and readmitted patients in the TCP-AZP 2013-2015.

| | All | Single admitted | Readmitted | p-value |
|---|---|---|---|---|
| N (%) | 895 (100) | 676 (75.5) | 219 (24.5) | |
| Age (mean years ± SD) | 64.32 (14.0) | 65.29 (14.4) | 63.38 (13.8) | 0.086 |
| Type of admission, N (%) | | | | 0.296 |
| Primary HF admission | 735 (82.1) | 550 (81.4) | 185 (84.5) | |
| Secondary HF admission | 160 (17.9) | 126 (18.6) | 34 (15.5) | |
| Sex | | | | 0.761 |
| Male | 462 (51.6) | 347 (51.3) | 115 (52.5) | |
| Female | 433 (48.4) | 302 (50.5) | 104 (47.5) | |
| Ethnicity | | | | 0.247 |
| African (Creole & Tribal communities) | 308 (34.4) | 237 (35.1) | 71 (32.4) | |
| Asian (Hindustani, Javanese & Chinese) | 441 (49.3) | 323 (47.8) | 118 (53.9) | |
| Other (Indigenous, Caucasian, Mixed) | 146 (16.3) | 116 (17.2) | 30 (13.7) | |
| Left ventricle function | | | | 0.058 |
| LVrEF (EF<40%) | 339 (42.2) | 241 (40.2) | 98 (47.8) | |
| LVpEF (EF>40%) | 465 (57.8) | 385 (59.8) | 107 (52.2) | |
| Risk factors | | | | |
| HT | 650 (72.6) | 488 (72.1) | 162 (74.0) | 0.607 |
| DM | 348 (38.9) | 259 (38.3) | 89 (40.6) | 0.539 |
| Cholesterol | 45 (5.0) | 30 (4.4) | 15 (6.8) | 0.156 |
| Smoking | 155 (17.3) | 112 (16.6) | 43 (19.6) | 0.297 |
| >2 RF | 103 (11.5) | 71 (10.5) | 32 (14.6) | 0.098 |
| Length of stay, days | | | | |
| Average (SD) | 7.3 (7.1) | 7.2 (6.8) | 7.5 (6.8) | 0.632 |

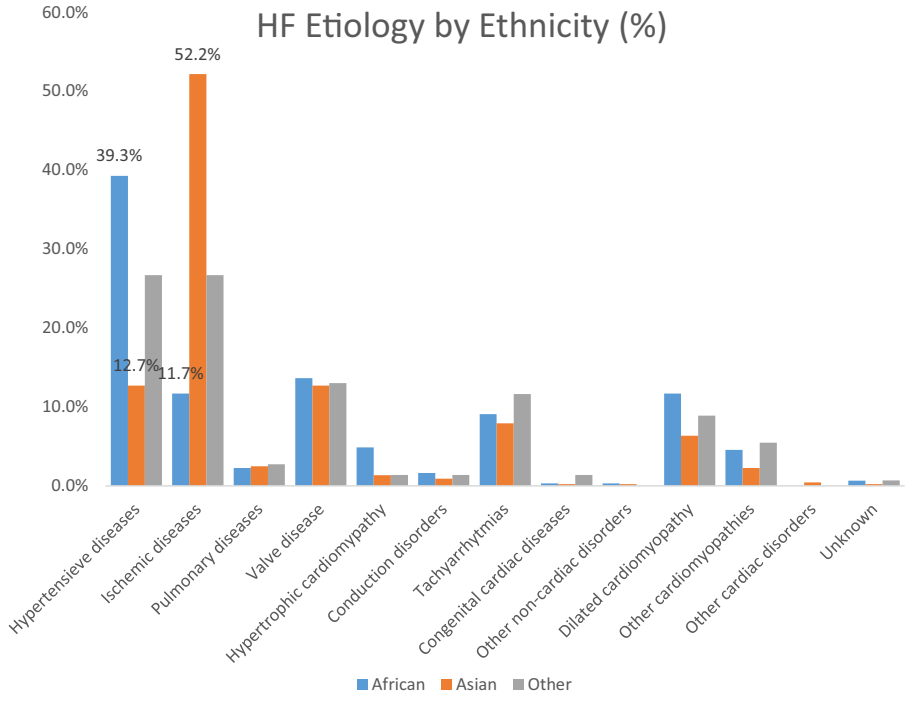
*All presented variables are calculated using single admission data and first admission data (for readmitted patients).*

*HT, Hypertension; DM, Diabetes Mellitus; RFs, Risk Factors; LVrEF, Left Ventricle with reduced ejection fraction; LVpEF, Left Ventricle with preserved ejection fraction; SD, standard deviation.*

years) and Western Europe (72 years) as expected, but is in line with other upper middle income countries like Jamaica and Brazil and higher than most countries in Africa and Asia.[32-37] The Hindustani sub-cohort was more frequently admitted for HF admissions, followed by Creole and Javanese which differs slightly from the size of the three largest ethnic groups in Suriname, respectively Hindustani, Tribal communities and Creole.[20] This difference may be partly explained by the differential access of care since the AZP is situated in the capital and people from the rural regions, specifically Tribal and Indigenous communities, may have difficulty accessing AZP health services. The Suriname Healthy study and the Healthy Life in Suriname (HeliSur) study have shown that Hindustani and Creole people have high prevalence of CVD risk factors such as DM and HT rates, which is in line with the high prevalence found in our study.[23,28,29] HF admissions due to IHD were twice as high in patients of Asian descent compared to HF patients of African descent, whereas HHD was more prevalent in HF patients of African descent compared to patients of Asian descent. This is in line with studies, showing that atherosclerotic diseases and IHD are more prevalent in Asian and HHD in Africans.[4,6,11,38,39]

The 30-day CVD-cause readmission rate of 7% was relatively low compared to the U.S. (10%) but higher than most European and other South-American countries (1.8%-5.6%), However, the available data were from the Thorax Center Paramaribo only and thus all cause-

**Figure 2.** Heart failure etiology by ethnicity at index admission. African: Creole and Tribal communities. Asian: Chinese, Hindustani and Javanese. Other: all other ethnicities.




readmissions for HF patients remain unknown in our study population.[40]

## *Limitations*

We did not find any significant differences in demographic and clinical characteristics between single and readmitted patients in contrast to other studies showing that older age, LV function <45% and an increase in the number of risk factors do increase the risk of rehospitalizations.[41-43] Our results may be explained by the nature of the database (no actual follow-up of patients nor does the database has outpatient monitoring data) and the patient population (all HF patients included in the study period older than 18 years, compared to newly diagnosed patients). This also permits us from doing any robust statistics including follow-up analyses such as a survival analysis. In addition, our study design was a single center cross-sectional study design and for that reason we cannot generalize these results to the entire country, however as stated before, 80% of all HF admissions are in the TCP-AZP. Due to the retrospective nature of the data collection, there may be collection bias and differences in the quality and extent of information for the patient records since the intent of this database is merely for clinical documentation of patients' admissions and thus critical follow-up and other study variables are lacking. Nevertheless the aim of this study was to descriptively present the basic demographic and clinical features of HF patients in the largest hospital in Suriname.

From our results and the mentioned limitations it is clear that further research into the management and the related HF outcomes is needed in Suriname. Currently, we are setting up a database to prospectively collect data on all HF admissions in the country as well as setting up a HF management program of which the effect will be studied in the SUHF-II. This IRB approved prospective interventional study will assess the effect of two outpatient management programs at a HF clinic in order to compare the prognosis of these programs. These programs were developed based on the evidence that close monitoring of HF patients in an outpatient setting improve their quality of life and reduce re-hospitalization and mortality rates.[44-48] HF patients (>18 years) from the TCP-AZP will be randomly divided between two groups after a HF hospitalization, with a 3 month follow-up. Both groups of patients will receive HF care delivered by a trained nurse and physician and the observed ethnic and sex differences in HF variables in the SUHF−I study will be incorporated. Additionally, the intervention group one will get seven interactive educational and motivational sessions with an emphasis on HF lifestyle adherence, promoting physical activity and self-management specifically designed for the Suriname HF population. The study outcomes will be re-hospitalization rates at 30 and 90 days, quality of life

and physical activity status. Furthermore, data on HF knowledge, therapy adherence and country specific factors will be collected. With the SUHF-II data, the TCP-AZP hopes to implement the first reimbursed healthcare chronic-care model program by improving the HF healthcare delivery and addressing country-specific factors that affect the lifestyle and medication adherence, such as a suboptimal healthcare system, low health literacy rate and lack of cardiac rehabilitation.

### *Conclusion/implications*

The results from this retrospective analysis, SUHF I, demonstrate that there are clear sex and ethnic differences in terms of age, risk factors and etiology in Surinamese HF patients. In addition, the results clearly show the need for an improved HF registry, proper monitoring and further in-depth studies into specific HF patient characteristics, care and outcome. The SUHF-II study will address these factors and give important information which may be used to further develop and refine cardiovascular care for the people of Suriname.

The SUHF−I data were completed and analyzed prior to the COVID-19 pandemic. This pandemic also shows the disparities in health and access to adequate healthcare among regions and ethnicities with worse outcomes for black people compared to whites in the U.S.[49] The Suriname national COVID-19 crisis management team faces large challenges to maintain low transmission rates especially in the interior and the country borders. As of June 29, 2020 Suriname has 492 confirmed cases, of which 199 recovered, 13 death and 341 in quarantine. The already fragile healthcare system has been disrupted and only acute medical consultations are now being done since March 13th when the first case was confirmed. Before starting the SUFH-II study, we will assess the hospital admissions for HF during this pandemic. Despite any future impact of COVID-19, it is expected that the SUFH-II study will start this year ensuring the safety, inclusivity and wellbeing of the patients as well as the medical personnel.[50]

## FINANCIAL DISCLOSURE

Research reported in this publication was supported by the Fogarty International Center of the National Institutes of Health under award numbers U01TW010087 and U2RTW010104. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

## CONFLICT OF INTEREST

The Authors have no conflict of interests to declare. The research paper was not funded by a grant.

## REFERENCES

1. Metra, M., & Teerlink, J. R. (2017). Heart failure. *Lancet, 390*(10106), 1981−1995.
2. Heidenreich, P. A., Albert, N. M., Allen, L. A., et al. (2013). Forecasting the impact of heart failure in the United States: a policy statement from the American heart association. *Circ Hear Fail, 6*(3), 606−619.
3. Rodrigues, M. M., Alvarez, A. M., & Rauch, K. C. (2019). Trends in hospitalization and mortality for ambulatory care sensitive conditions among older adults. *Rev Bras Epidemiol, 22*, e190010.
4. Dokainish, H., Teo, K., Zhu, J., et al. (2017). Global mortality variations in patients with heart failure: results from the International Congestive Heart Failure (INTER-CHF) prospective cohort study. *Lancet Glob Heal, 5*(7), e665−e672.
5. Kristensen, S. L., Køber, L., Jhund, P. S., et al. (2015). International geographic variation in event rates in trials of heart failure with preserved and reduced ejection fraction. *Circulation, 131*(1), 43−53.
6. Dokainish, H., Teo, K., Zhu, J., et al. (2016). Heart failure in Africa, Asia, the Middle East and South America: the INTER-CHF study. *Int J Cardiol, 204*, 133−141.
7. Sidney, S., Quesenberry, C. P., Jaffe, M. G., et al. (2016). Recent trends in cardiovascular mortality in the United States and public health goals. *JAMA Cardiol, 1*(5), 594−599.
8. Mitchell, J. E., Ferdinand, K. C., Watson, K. E., et al. (2011). Treatment of heart failure in African Americans - a call to action. *J Natl Med Assoc, 103*(2), 86−98.
9. Tillman, F., Kim, J., Makhlouf, T., & Osae, L. (2019). A comprehensive review of chronic heart failure pharmacotherapy treatment approaches in African Americans. *Ther Adv Cardiovasc Dis, 13*.
10. Lip, G., Zarifis, J., & Beevers, D. G. (1997). Acute admissions with heart failure to a district general hospital serving a multiracial population. *Int J Clin Pract, 51*(4), 223−227. http://www.ncbi.nlm.nih.gov/pubmed/9287263. Accessed June 10, 2020.
11. Nunura, F. (2017). Heart failure in afro-caribbean: a cardiovascular Enigma. *J Cardiol Cardiovasc Ther, 3*, 555611.
12. Dungu, J. N., Papadopoulou, S. A., Wykes, K., et al. (2016). Afro-caribbean heart failure in the United Kingdom. *Circ Hear Fail, 9*(9), e003352.
13. Lalljie, G., & Lalljie, S. (2007). Characteristics, treatment and short-term survival of patients with heart failure in a cardiology private practice in Jamaica. *West Indian Med J, 56*(2), 139−143.

14. Nunura, F., Tulloch-Reid, E., Baugh, D. S., & Madu, E. C. (2017). Heart failure demographic and clinical features: the caribbean perspective. A single-center 100-case series discussion and review of the literature. *Biomed J Sci Tech Res, 1*(4).

15. Benjamin, E. J., Muntner, P., Alonso, A., et al. (2019). Heart disease and stroke statistics-2019 update: a report from the American heart association. *Circulation, 139*(10), e56–e528.

16. Ajayi, A. A., Sofowora, G. G., & Ladipo, G. O. (2020). Explaining heart failure hyper-mortality in sub saharan Africa: global genomic and environmental contribution review. *J Natl Med Assoc, 112*(2), 141–157.

17. Yancy, C. W., Jessup, M., Bozkurt, B., et al. (2013). 2013 ACCF/AHA guideline for the management of heart failure: a report of the American college of cardiology foundation/american heart association task force on practice guidelines. *J Am Coll Cardiol, 62*(16), e147–e239.

18. Ferdinand, K. C., Senatore, F. F., Clayton-Jeter, H., et al. (2017). Improving medication adherence in cardiometabolic disease: practical and regulatory implications. *J Am Coll Cardiol, 69*(4), 437–451.

19. Ministry of Social Affairs and Housing and General Bureau of Statistics 2012. (2013). Suriname multiple indicator cluster survey 2010, final report: Paramaribo, Suriname. www.childinfo.org.

20. General Bureau of Statistics. (2013). *Results 8th Census in Suriname (Volume 1) Demografic and Social Characteristics and Migration*.

21. WHO - World Health Organization. (2018). WHO Mortality Database. Data set. https://apps.who.int/healthinfo/statistics/mortality/whodpms/. Accessed June 19, 2020.

22. Department Epidemiologie & Biostatistiek. (2012). *Doodsoorzaken in Suriname (Causes of Death) 2010-2011*.

23. Diemer, F. S., Baldew, S.-S. M., Haan, Y. C., et al. (2017). Hypertension and cardiovascular risk profile in a middle-income setting: the HELISUR study. *Am J Hypertens, 30*(11), 1133–1140.

24. Baldew, S.-S. M., Diemer, F. S., Cornelissen, V., et al. (2019). Physical activity and obesity: is there a difference in association between the Asian- and African- Surinamese adult population? *Ethn Health, 24*(4), 365–377.

25. Diemer, F. S., Baldew, S.-S. M., Haan, Y. C., et al. (2020). Aortic pulse wave velocity in individuals of Asian and African ancestry: the HELISUR study. *J Hum Hypertens, 34*(2), 108–116.

26. Krishnadath, I. S. K., Toelsie, J. R., Hofman, A., & Jaddoe, V. W. V. (2016). Ethnic disparities in the prevalence of metabolic syndrome and its risk factors in the Suriname Health Study: a cross-sectional population study. *BMJ Open, 6*(12), e013183.

27. Krishnadath, I. S., Smits, C. C., Jaddoe, V. W., Hofman, A., & Toelsie, J. R. (2015). A national surveillance survey on non-communicable disease risk factors: Suriname health study protocol. *JMIR Res Protoc, 4*(2), e75.

28. Krishnadath, I. S. K., Jaddoe, V. W. V., Nahar-van Venrooij, L. M., & Toelsie, J. R. (2016). Ethnic differences in prevalence and risk factors for hypertension in the Suriname Health Study: a cross sectional population study. *Popul Health Metrics, 14*(1), 33.

29. Krishnadath, I. S. K., Nahar-van Venrooij, L. M., Jaddoe, V. W. V., & Toelsie, J. R. (2016). Ethnic differences in prediabetes and diabetes in the Suriname Health Study. *BMJ Open Diabetes Res Care, 4*(1), e000186.

30. Jairam, V., Gokoel, A., Sairras, S., Samidin, L., & Jairam, M. (2019). *Avoidable Hospitalizations for Primary Care Sensitive Conditions in Suriname*. Paramaribo.

31. McMurray, J. J. V., Adamopoulos, S., Anker, S. D., et al. (2012). ESC guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: the task force for the diagnosis and treatment of acute and chronic heart failure 2012 of the European society of cardiology. Developed in collaboration with the heart failure association (HFA) of the ESC. *Eur Heart J, 33*(14), 1787–1847.

32. Filippatos, G., Angermann, C. E., Cleland, J. G. F., et al. (2020). Global differences in characteristics, precipitants, and initial management of patients presenting with acute heart failure. *JAMA Cardiol, 5*(4), 401–410.

33. Cleland, J. G. F., Swedberg, K., Follath, F., et al. (2003). The EuroHeart Failure survey programme– a survey on the quality of care among patients with heart failure in Europe. Part 1: patient characteristics and diagnosis. *Eur Heart J, 24*(5), 442–463. http://www.ncbi.nlm.nih.gov/pubmed/12633546. Accessed May 1, 2020.

34. Akintoye, E., Briasoulis, A., Egbe, A., et al. (2017). National trends in admission and in-hospital mortality of patients with heart failure in the United States (2001-2014). *J Am Heart Assoc, 6*(12), e006955.

35. Celermajer, D. S., Chow, C. K., Marijon, E., Anstey, N. M., & Woo, K. S. (2012). Cardiovascular disease in the developing world: prevalences, patterns, and the potential of early disease detection. *J Am Coll Cardiol, 60*(14), 1207–1216.

36. Bocchi, E. A., Arias, A., Verdejo, H., Diez, M., Gómez, E., & Castro, P. (2013). The reality of heart failure in Latin America. *J Am Coll Cardiol, 62*(11), 949–958.

37. Blecker, S., Paul, M., Taksler, G., Ogedegbe, G., & Katz, S. (2013). Heart failure-associated hospitalizations in the United States. *J Am Coll Cardiol, 61*(12), 1259–1267. https://doi.org/10.1016/j.jacc.2012.12.038.

38. Cappuccio, F. P. (1997). *Ethnicity and Cardiovascular Risk: Variations in People of African Ancestry and South Asian Origin* (vol. 11). http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.579.8871&rep=rep1&type=pdf. Accessed January 6, 2019.

39. Dewan, P., Jhund, P. S., Shen, L., et al. (2019). Heart failure with reduced ejection fraction: comparison of patient characteristics and clinical outcomes within Asia and between Asia, Europe and the Americas. *Eur J Heart Fail, 21*(5), 577–587.

40. Khan, H., Greene, S. J., Fonarow, G. C., et al. (2015). Length of hospital stay and 30-day readmission following heart failure hospitalization: insights from the EVEREST trial. *Eur J Heart Fail, 17*(10), 1022–1031.

41. Mahajan, S. M., Heidenreich, P., Abbott, B., Newton, A., & Ward, D. (2018). Predictive models for identifying risk of readmission after index hospitalization for heart failure: a systematic review. *Eur J Cardiovasc Nurs, 17*(8), 675–689.

42. Su, A., Al'Aref, S. J., Beecy, A. N., Min, J. K., & Karas, M. G. (2019). Clinical and socioeconomic predictors of heart failure readmissions: a review of contemporary literature. *Mayo Clin Proc, 94*(7), 1304–1320.

43. Betihavas, V., Newton, P. J., Frost, S. A., MacDonald, P. S., & Davidson, P. M. (2013). Patient, provider and system factors influencing rehospitalisation in adults with heart failure. *Contemp Nurse, 43*(2), 244–256.

44. After a heart attack, physical activity makes you feel better | EurekAlert! Science News. https://www.eurekalert.org/pub_releases/2020-04/esoc-aah042420.php. Accessed April 29, 2020.

45. Banchs-Pieretti, H. L., Franqui-Rivera, H., Segarra-Alonso, O., et al. (2008). *Analysis of Heart Failure Management at the Heart Failure and Transplantation Clinics of the Cardiovascular Center of Puerto Rico and the Caribbean*.

46. Guidi, G., Pollonini, L., Dacso, C. C., & Iadanza, E. (2015). A multilayer monitoring system for clinical management of Congestive Heart Failure. *BMC Med Inform Decis Mak, 15*(Suppl 3), S5.

47. Koehler, F., Koehler, K., Deckwart, O., et al. (2018). Telemedical Interventional Management in Heart Failure II (TIM-HF2), a randomised, controlled trial investigating the impact of telemedicine on unplanned cardiovascular hospitalisations and mortality in heart failure patients: study design and description. *Eur J Heart Fail Suppl, 20*(10), 1485–1493.

48. Takeda, A., Martin, N., Taylor, R. S., & Taylor, S. J. C. (2019). Disease management interventions for heart failure. *Cochrane Database Syst Rev, 2019*(1), CD002752.

49. Ferdinand, K. C., & Nasser, S. A. (2020). African American COVID-19 mortality: a sentinel event. *J Am Coll Cardiol, 75*(21), 2746–2748.

50. Abraham, W. T., Fiuzat, M., Psotka, M. A., & O'Connor, C. M. (2020). Heart failure collaboratory statement on clinical trials in the landscape of COVID-19. *JACC Hear Fail, 8*(5), 423–425.