Administrative Data–Based Staging of the Heart Failure Continuum in a Nationwide Population

Short title: Nationwide Administrative Staging of Heart Failure

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Abstract

Background

Population-level data on preclinical heart failure (HF) remain limited because most epidemiological studies focus on symptomatic HF. We therefore developed an administrative-data algorithm to classify HF stages across the national population and describe temporal trends, stage transitions, and mortality across the HF continuum.

Methods

Using a claims-based staging framework adapted from the Universal Definition of HF, we classified HF stages from ICD-10 codes, prescription records, and medical procedures. We applied this algorithm to the Czech population, linking the National Registry of Reimbursed Health Services to National mortality records from 2015 to 2024.

Results

In 2024, 27.8% of the Czech population met criteria for Stage A HF and 8.2% for Stage B. Over 10 years, the prevalence of both preclinical stages increased beyond what could be explained by population aging alone, with age-standardized prevalence rising by 9.5% for Stage A and 19.2% for Stage B. Age-standardized 1-year mortality showed a steep stepwise gradient, from 0.69% in Stage A to 1.69% in Stage B, 3.06% in Stage C, and 7.27% in Stage D. Among 52,172 individuals with incident clinical HF in 2024, more than 95% had previously met administrative criteria for Stage A or Stage B.

Conclusion

Administrative surveillance of the HF continuum using routinely collected healthcare data provides a scalable administrative framework for population-level monitoring of HF burden. In Czechia, both preclinical and clinical HF burdens increased over time beyond population aging alone, underscoring the need for earlier preventive strategies targeting preclinical disease.

Keywords: heart failure, staging, prevalence, administrative data, mortality, epidemiology

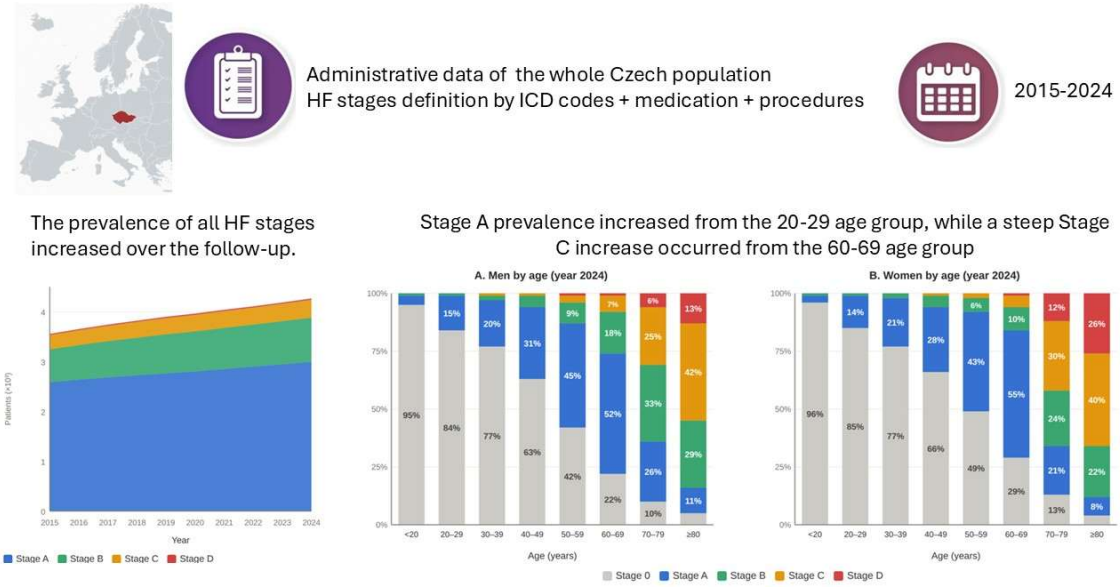
Clinical Perspective

- We developed a nationwide administrative-data algorithm that classifies the full heart failure continuum (Stages A–D) using routinely collected ICD-10 diagnoses, prescription claims, and procedure codes, showing that both preclinical and clinical HF burdens are rising beyond what population aging explains.

- More than 95% of individuals who developed clinical HF had previously met administrative criteria for Stage A or Stage B, suggesting that progression to overt disease is often preceded by an identifiable preclinical phase that may represent an opportunity for prevention.

- This scalable, low-cost surveillance framework enables health systems to identify at-risk populations, track HF trends over time, and target preventive strategies toward preclinical stages, an approach that could be adapted internationally to inform policy and resource allocation.

Graphical abstract



Conclusion: A population-wide HF staging system based on administrative data enables surveillance of the HF epidemic. In Czechia, the burden of preclinical and clinical HF is increasing.

Introduction

Heart failure (HF) is a major and growing global public health challenge, affecting more than 64 million people worldwide and accounting for a substantial burden of disability, hospitalization, and healthcare expenditure.[1] Although age-standardized HF incidence has stabilized or declined in many high-income countries, the overall prevalence continues to increase owing to improved survival and population aging.[2, 3] At the same time, rising rates of obesity, diabetes, and other cardiometabolic disorders are contributing to an increasing incidence of HF among younger adults, suggesting that the future burden of HF may continue to grow despite advances in treatment.[4-6]

Heart failure develops gradually along a continuum that begins with exposure to cardiovascular risk factors (Stage A), progresses through asymptomatic structural or functional cardiac abnormalities (Stage B), and ultimately culminates in symptomatic (Stage C) and advanced HF (Stage D).[7] Because this process often unfolds over many years, identifying individuals in preclinical stages offers an opportunity to prevent or delay overt HF through aggressive risk-factor modification and early intervention.[8-10]

Despite the importance of preclinical disease, contemporary HF epidemiology remains focused largely on symptomatic HF. Most national registries and administrative databases capture only patients with established clinical HF, whereas Stages A and B are poorly characterized at the population level. As a result, healthcare systems have limited ability to quantify the reservoir of individuals at risk for future HF, evaluate trends across the full disease continuum, or monitor the potential impact of preventive strategies. In addition, reliance on diagnostic coding alone may underestimate the burden of clinical HF, because many patients receive HF-directed pharmacotherapy without a formal HF diagnosis being recorded.

The 2021 Universal Definition and Classification of Heart Failure provides a contemporary framework for staging HF across its full clinical spectrum.[7] However, its implementation has largely been confined to clinical cohorts with detailed imaging and biomarker assessment, limiting its application to population-wide surveillance. Whether this

framework can be operationalized for nationwide surveillance using routinely collected administrative healthcare data remains uncertain.

By integrating ICD-10 diagnoses, prescription claims, and procedural records, we approximated the HF continuum across the Czech population and used linked healthcare and mortality data to examine prevalence, temporal trends, stage transitions, mortality, and treatment patterns from 2015 through 2024. Our goal was not only to describe the epidemiology of HF, but also to establish a scalable approach for monitoring the full HF continuum at the population level.

Methods

Data source

The present analysis used data from the National Health Information System (NHIS), managed by the Institute of Health Information and Statistics of Czechia (IHIS CR). The NHIS is established under § 70 par. 1 of Act No. 372/2011 Coll., on Health Services and Conditions of Their Provision (Act on Health Services). Due to this legal mandate, the retrospective analyses did not require either ethics committee approval or participant informed consent. For this study, data were extracted from the National Registry of Reimbursed Health Services (NRRHS), which provides an overview of insured individuals and their records from the public health insurance system. The dataset is further linked to the national death registry. Health insurance is mandatory for all residents and employees of companies based in Czechia; therefore, this population-based analysis includes all Czech citizens (10.9 million as of December 31, 2024).

Heart failure stages classification

A staging framework for HF was introduced in 2005 based on expert consensus.[11] Since its introduction, multiple observational and cohort studies have validated the clinical utility and prognostic relevance of this staging system by demonstrating a consistent gradient in both mortality risk and the likelihood of progression to overt HF across the stages.[12-14] In 2021, the

Universal Definition of HF revised its staging system to incorporate cardiac biomarkers.[7] This revision increased the number of individuals classified as stage B HF.[15]

In the present study, we developed a claims-based staging framework adapted from the 2021 Universal Definition of Heart Failure using routinely collected administrative healthcare data. Because imaging findings, natriuretic peptides, and standardized symptom assessment were not available, direct implementation of the Universal Definition was not possible. We therefore introduced pragmatic modifications by integrating International Classification of Diseases (ICD-10) codes, prescription claims, and procedural records to define each HF stage. Beyond the criteria outlined in the Universal Definition, we also included selected comorbid conditions with established associations with increased HF risk. HF stages were assigned hierarchically in the following order: Stage D, Stage C, Stage B, Stage A, and Stage 0, such that each individual could belong to only one stage in a given calendar year.

Stage A was defined by exposure to HF risk factors—arterial hypertension, diabetes mellitus, obesity, alcohol abuse, chronic kidney disease (CKD), atherosclerotic cardiovascular disease (prior percutaneous coronary intervention or coronary artery bypass grafting without myocardial infarction history, and stroke history) and cardiotoxic cancer therapies, without any features of stage B, C, or D HF. Although CKD is not explicitly listed in the Universal Definition, we included it in stage A based on multiple lines of evidence showing that CKD is an independent risk factor for HF.[16-18]

Stage B was defined by evidence of structural cardiac abnormalities in the absence of criteria for Stage C or D, in accordance with the 2021 Universal Definition. We also included atrial fibrillation in Stage B, as it is associated with structural heart disease, being both a consequence of, and a contributor to, left atrial enlargement.[19] Atrial fibrillation also independently increases the risk of developing HF.[20] We further classified patients with pacemaker implantation under Stage B, as pacing-induced cardiomyopathy has been reported in 10–20% of individuals within 3 to 4 years post-implantation.[21] Moreover, up to 21% of patients with right ventricular pacing develop new-onset HF.[22, 23] In addition, we included implantable cardioverter-defibrillator (ICD) implantation in the absence of pharmacological

treatment for symptomatic HF under stage B, as the most common indication for ICDs is underlying systolic dysfunction. We also classified patients receiving furosemide, spironolactone, or eplerenone without an HF-related ICD-10 code as Stage B, provided that no Stage C or D criteria were present. This reflects the fact that many patients receive HF-targeted pharmacotherapy without formal HF coding, particularly in outpatient settings, consistent with Glasgow health record data showing loop diuretic use is more strongly associated with mortality than a recorded HF diagnosis alone.[24]

To evaluate the potential influence of these pragmatic Stage B extensions, we performed a sensitivity analysis excluding individuals classified as Stage B solely on the basis of atrial fibrillation or pacemaker implantation. Under this restricted Stage B definition, the number of individuals classified as Stage B in 2024 decreased from 886,952 to 628,875, a 29.1% reduction. Despite this reduction, mortality estimates remained similar: crude 1-year mortality increased from 4.0% to 4.1%, and age-adjusted mortality increased from 1.7% to 1.9%. These findings suggest that inclusion of atrial fibrillation and pacemaker implantation increased the sensitivity of Stage B ascertainment without materially weakening the observed mortality gradient across HF stages.

Stage C Patients were classified as Stage C if they had: (1) an HF-specific ICD-10 code (I11.0, I13.0, I13.2, I25.5, I42.0, I42.9, I50, or R57.0) as a primary inpatient diagnosis; (2) a broader cardiac disease ICD-10 code (I05–I09, I11.0, I13.0, I13.2, I21–I25, I34–I37, I39, I40–I43, I50, Q20–Q24, or R57.0) as a secondary inpatient diagnosis or a primary outpatient specialist diagnosis, combined with a prescription for furosemide, spironolactone, eplerenone, or sacubitril-valsartan within 90 days; (3) an HF-related implantation procedure or device; or (4) a sacubitril-valsartan prescription alone, given its exclusive HF indication in the Czech reimbursement setting.

Stage D was defined by the history of heart transplantation, left ventricular assist device implantation, or two or more hospital admissions for HF over the past year.

Incident clinical HF in 2024 was defined as the first classification into Stage C or D in 2024 among individuals without Stage C/D classification during the preceding 10-year look-back period.

Statistical analysis

Standard descriptive statistics were used in the analysis: absolute and relative frequencies for categorical variables and means with standard deviations for continuous variables. Incidence, prevalence, and mortality rates were age-standardized to the 2013 European Standard Population (ESP 2013), with results reported per 100,000 population. Data preprocessing was performed using the Vertica Analytic Database, followed by statistical analyses in R (R Core Team, 2025).

Results

Prevalence of HF stages (2015-2024)

The prevalence of all HF stages increased over the study period (**Supplementary Figure 1**). **Table 1** presents the demographic characteristics of HF stages in 2024.

Stage A

The crude prevalence of individuals with Stage A HF increased from 247.7 per 1,000 in 2015 to 277.6 per 1,000 in 2024, a 12.1% rise (**Table 2**). Additionally, the age-standardized prevalence increased from 244.1 per 1,000 in 2015 to 267.2 per 1,000 in 2024, a 9.46% increase.

Stage B

The crude prevalence of Stage B increased from 63.1 per 1,000 in 2015 to 82.2 per 1,000 in 2024, a 30.4% rise. The age-standardized prevalence also rose by 19.2%, from 64 per 1,000 to 77 per 1,000.

Stages C and D

The crude prevalence of Stage C increased from 28 per 1,000 in 2015 to 33 per 1,000 in 2024, reflecting a 21.1% rise. The age-standardized prevalence also rose by 5.2%, from

29.5 per 1,000 to 31.0 per 1,000. After 2020, however, the standardized prevalence of Stage C increased only modestly.

Similarly, between 2015 and 2024, the crude prevalence of Stage D increased by 18.4%, while the age-standardized prevalence rose by 4.1%. However, a nonlinear trend in standardized prevalence was observed, with a peak in 2019 followed by a plateau, coinciding with the COVID-19 period and possibly reflecting increased mortality in this high-risk group (**Supplementary Figure 2**).

Age-specific distribution of HF stages

To determine the age at which the prevalence of each HF stage begins to increase, we plotted the 2024 stage-specific prevalence across the age groups (**Figure 1**). The proportion of individuals classified as Stage A increased from early adulthood through the 60–69 age group and then declined at older ages as Stages B–D became increasingly prevalent. No difference in pattern was observed between men and women. Stage B exhibited a sharp increase in prevalence starting from the 40–49 age group. The prevalence of Stage C began to rise from the 60–69 age group onward, with a similar pattern of increase in women and men.

Transition of HF stages

Among individuals classified as Stage A in 2015, 13.2% were classified as Stage B in 2024, 4.9% as Stage C, and 0.3% as Stage D by 2024 (**Figure 2, Supplementary table 3**). In 2024, among 52,172 individuals with incident clinical HF, more than 95% had previously been classified as Stage A or B.

Mortality risk by HF stages

Analysis of data from 2024 demonstrated a stepwise rise in 1-year mortality with advancing heart failure stage (**Figure 3**). Unstandardized and age-standardized 1-year mortality rates were 0.12% and 0.45% for Stage 0, rising to 0.97% and 0.69% in Stage A,

4.00% and 1.69% in Stage B, 9.49% and 3.06% in Stage C, and 18.73% and 7.27% in Stage D, respectively (**Table 3**). Compared with Stage 0, the age-standardized relative mortality risk rose progressively across HF stages—1.53 in Stage A, 3.76 in Stage B, 6.8 in Stage C, and 16.2 in Stage D. As the HF stage increased, the proportion of deaths attributed to cardiovascular causes rose from 21.5% in Stage 0 to 60.2% in Stage D, while the proportion of deaths due to neoplasms declined from 34.5% in Stage 0 to 9.4% in Stage D (**Supplementary Table 2**).

Pharmacotherapy of symptomatic HF stages

A substantial treatment gap was observed in the pharmacotherapy of symptomatic HF stages. Among patients in Stage C, 24% received sodium-glucose cotransporter 2 (SGLT2) inhibitors. This has increased by more than half compared with 2023. Just 6% received angiotensin receptor–neprilysin inhibitors (ARNIs). Although these rates remain suboptimal, they should be interpreted in the context of the rapid implementation of SGLT2 inhibitors in the Czech Republic. Reimbursement for dapagliflozin in heart failure with reduced ejection fraction (HFrEF) became available in February 2022, followed by reimbursement for empagliflozin across the full spectrum of left ventricular ejection fraction in May 2023 and for dapagliflozin in March 2024. In Stage D, the use of guideline-recommended therapies increased modestly, with 51% receiving SGLT2 inhibitors and 24% receiving ARNIs. In contrast, 15% of patients in Stage D were prescribed calcium channel blockers, a therapy that is generally not part of guideline-directed treatment for advanced HFrEF and may reflect competing indications or residual prescribing inertia (**Table 1**).

Discussion

In this nationwide study of 10.9 million Czech residents, we developed and applied a nationwide claims-based staging framework aligned with the 2021 Universal Definition of HF, using routinely collected administrative healthcare data to approximate the HF continuum over a 10-year period. Four principal findings emerge. First, we demonstrate that nationwide

administrative data can be used to classify all HF stages, enabling surveillance of the disease continuum beyond clinically overt HF. Second, the prevalence of both preclinical HF stages increased substantially over time, even after age standardization, indicating that the growing HF burden cannot be explained by population aging alone. Third, more than 95% of individuals who developed clinical HF had previously been classified as Stage A or B, highlighting a prolonged and potentially modifiable preclinical phase. Finally, despite recent improvements, substantial gaps remain in the implementation of guideline-directed medical therapy among patients with symptomatic HF.

Current epidemiological surveillance primarily focuses on symptomatic HF, whereas the preclinical stages remain poorly characterized at the population level. Most available data originate from prospective cohort studies,[12, 25-27] which provide valuable mechanistic insights but are limited by selective recruitment, restricted age ranges, and relatively small sample sizes. Consequently, they are not ideally suited for monitoring nationwide trends or informing healthcare planning. By contrast, administrative healthcare databases encompass entire populations and are continuously updated, making them an attractive resource for population-level surveillance. Until now, however, the absence of a standardized administrative definition of HF stages has limited their application to the full HF continuum.

To address this gap, we operationalized the 2021 Universal Definition of HF within routinely collected administrative healthcare data. Because administrative datasets lack imaging and biomarker information required by the original definition, our framework incorporates pragmatic modifications based on diagnostic codes, prescription claims, and procedural records.

We also refined the definition of symptomatic HF to improve case ascertainment. Because HF is frequently undercoded in administrative databases, particularly among patients with preserved ejection fraction or those managed without hospitalization, we supplemented HF-specific diagnostic codes with a combination of broader cardiac disease codes and pharmacotherapy strongly suggestive of symptomatic HF (furosemide, spironolactone, eplerenone, or sacubitril-valsartan) within 90 days of the diagnostic code, as an indicator of

Stage C disease. A prescription for sacubitril-valsartan alone was also sufficient to classify a patient as Stage C, given its near-exclusive indication for symptomatic HF.

These adaptations reflect the inherent limitations of administrative data, which do not capture echocardiographic findings or cardiac biomarkers required by the Universal Definition. Although this approach cannot achieve the diagnostic precision of comprehensive clinical phenotyping, it enables standardized HF staging at the population level using routinely available healthcare data. Future validation against echocardiographic registries and clinical datasets incorporating imaging and biomarker information will be essential to further establish the diagnostic performance of this administrative staging algorithm. The resulting framework demonstrated strong construct validity, with a progressive increase in both all-cause and cardiovascular mortality across successive HF stages, closely mirroring observations from community-based cohort studies.[12, 15] Together, these findings support the use of this framework for nationwide surveillance of the HF continuum and for facilitating comparisons of HF burden across healthcare systems.

A particularly important finding is the substantial increase in the prevalence of Stage A and Stage B HF during the study period. Although population aging contributes to the increasing burden of HF, age-standardized prevalence also rose considerably, indicating that demographic changes alone do not explain these trends. While causal inferences cannot be drawn from administrative data, the increasing prevalence of obesity and cardiometabolic disease in Czechia is a plausible contributor.[28] Rising obesity rates not only increase the risk of HF directly but also promote hypertension, diabetes mellitus, chronic kidney disease, and atrial fibrillation, thereby accelerating progression along the HF continuum. These findings suggest that the future burden of symptomatic HF will depend increasingly on the effectiveness of primary prevention strategies targeting cardiometabolic risk factors.

Perhaps the most clinically relevant observation is that more than 95% of individuals with incident clinical HF had previously fulfilled administrative criteria for Stage A or Stage B. Although this proportion depends on the performance of the staging algorithm, it demonstrates that progression to overt HF is rarely abrupt and is typically preceded by years of identifiable

cardiovascular risk or structural heart disease. This prolonged preclinical phase may represent the greatest opportunity for prevention. Our findings complement evidence from cohort studies suggesting that the majority of incident HF is attributable to a relatively small number of modifiable cardiovascular risk factors[29] and are consistent with recent recommendations advocating risk-based primary prevention of HF. Together, these observations support a shift in healthcare policy from reactive management of symptomatic HF toward earlier identification and intervention among individuals at increased risk, as outlined by the 2025 AHA Scientific Statement on risk-based primary prevention of HF.[30]

Our analysis also provides a contemporary overview of HF pharmacotherapy at the national level. Uptake of sodium-glucose cotransporter-2 inhibitors increased substantially between 2023 and 2024, reflecting the rapid implementation of recent guideline recommendations. Nevertheless, use of angiotensin receptor–neprilysin inhibitors remained low, and a considerable proportion of patients with advanced HF continued to receive medications with limited or uncertain benefit. Because all major guideline-directed HF therapies are reimbursed within the Czech healthcare system, these findings suggest that barriers to implementation are more likely related to therapeutic inertia, clinician awareness, or healthcare organization than to treatment availability.

The prevalence of Stage A and Stage B observed in our study was lower than that reported in community cohorts incorporating systematic echocardiography and biomarker assessment.[14, 31] This difference is expected because administrative databases cannot identify subclinical structural abnormalities, diastolic dysfunction, or elevated natriuretic peptide concentrations in asymptomatic individuals. Consequently, our estimates of preclinical HF should be regarded as conservative lower bounds. Conversely, the prevalence of symptomatic HF exceeded that reported in several Western European and North American populations,[32, 33] suggesting that the burden of clinical HF in Czechia remains substantial and deserves continued public health attention.

Beyond the findings from Czechia, the proposed administrative staging framework may provide a standardized methodology for monitoring the HF continuum across healthcare

systems. This framework could serve as a standardized methodology for international comparisons of HF epidemiology using routinely collected healthcare data, thereby facilitating benchmarking of disease burden, preventive strategies, and healthcare delivery.

Limitations

This study has several limitations. Administrative healthcare data are collected primarily for reimbursement rather than research purposes and therefore inevitably introduce some degree of disease misclassification. Several Stage A risk factors, including obesity and alcohol misuse, are incompletely captured by diagnostic coding, while important Stage B characteristics such as ventricular remodeling, diastolic dysfunction, and elevated cardiac biomarkers are unavailable. The proposed staging framework therefore cannot replace comprehensive clinical assessment. Furthermore, individual-patient-level validation against echocardiographic registries and datasets containing imaging and biomarker data will be necessary to quantify the sensitivity, specificity, and predictive value of the proposed staging algorithm. We cannot rule out the possibility that observed secular trends in stage prevalence may partly reflect changes in coding practices, diagnostic intensity, reimbursement policies, and uptake of cardiovascular therapies over time, rather than true changes in disease burden alone. Finally, although our findings are based on nationwide data with complete population coverage, validation in other healthcare systems will be important to establish the generalizability of this approach. Nevertheless, the consistent stepwise increase in all-cause and cardiovascular mortality across stages supports the construct validity of the framework.

Conclusion

In conclusion, routinely collected administrative healthcare data can be used to stage the HF continuum and support nationwide surveillance of both preclinical and clinical disease. In Czechia, the prevalence of preclinical HF increased substantially over time beyond what would be expected from population aging alone, indicating a growing reservoir of individuals at risk for future symptomatic HF. More broadly, this work provides a scalable framework for

monitoring HF epidemiology, evaluating preventive strategies, and benchmarking HF burden across healthcare systems.

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Data sharing statement

Individual participant data that underlie the results reported in this article will be available to researchers who provide a methodologically sound proposal with pre-defined aims.

References

1. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018;**392**(10159):1789-185810.1016/s0140-6736(18)32279-7.
2. Roger VL. Epidemiology of Heart Failure: A Contemporary Perspective. Circ Res 2021;**128**(10):1421-143410.1161/circresaha.121.318172.
3. Ran J, Zhou P, Wang J, Zhao X, Huang Y, Zhou Q, Zhai M, Zhang Y. Global, regional, and national burden of heart failure and its underlying causes, 1990–2021: results from the global burden of disease study 2021. Biomarker Research 2025;**13**(1):1610.1186/s40364-025-00728-8.
4. Christiansen MN, Køber L, Weeke P, Vasan RS, Jeppesen JL, Smith JG, Gislason GH, Torp-Pedersen C, Andersson C. Age-Specific Trends in Incidence, Mortality, and Comorbidities of Heart Failure in Denmark, 1995 to 2012. Circulation 2017;**135**(13):1214-122310.1161/circulationaha.116.025941.
5. Barasa A, Schaufelberger M, Lappas G, Swedberg K, Dellborg M, Rosengren A. Heart failure in young adults: 20-year trends in hospitalization, aetiology, and case fatality in Sweden. Eur Heart J 2014;**35**(1):25-3210.1093/eurheartj/eht278.
6. Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in Obesity Among Adults in the United States, 2005 to 2014. Jama 2016;**315**(21):2284-9110.1001/jama.2016.6458.
7. Bozkurt B, Coats AJS, Tsutsui H, Abdelhamid CM, Adamopoulos S, Albert N, Anker SD, Atherton J, Böhm M, Butler J, Drazner MH, Michael Felker G, Filippatos G, Fiuzat M, Fonarow GC, Gomez-Mesa JE, Heidenreich P, Imamura T, Jankowska EA, Januzzi J, Khazanie P, Kinugawa K, Lam CSP, Matsue Y, Metra M, Ohtani T, Francesco Piepoli M, Ponikowski P, Rosano GMC, Sakata Y, Seferović P, Starling RC, Teerlink JR, Vardeny O, Yamamoto K, Yancy C, Zhang J, Zieroth S. Universal definition and classification of heart failure: a report of the Heart Failure Society of America, Heart Failure Association of the European Society of Cardiology, Japanese Heart Failure Society and Writing Committee of the Universal Definition of Heart Failure: Endorsed by the Canadian Heart Failure Society, Heart Failure Association of India, Cardiac Society of Australia and New Zealand, and Chinese Heart Failure Association. Eur J Heart Fail 2021;**23**(3):352-38010.1002/ejhf.2115.
8. Yang H, Negishi K, Wang Y, Nolan M, Marwick TH. Imaging-Guided Cardioprotective Treatment in a Community Elderly Population of Stage B Heart Failure. JACC Cardiovasc Imaging 2017;**10**(3):217-22610.1016/j.jcmg.2016.11.015.
9. Gallagher J, Watson C, Campbell P, Ledwidge M, McDonald K. Natriuretic Peptide-based Screening and Prevention of Heart Failure. Card Fail Rev 2017;**3**(2):83-8510.15420/cfr.2017:20:1.
10. Faggiano P, Bernardi N, Calvi E, Bonelli A, Faggiano A, Bursi F, Bosisio M. Stage A Heart Failure: Modern Strategies for an Effective Prevention. Heart Fail Clin 2021;**17**(2):167-17710.1016/j.hfc.2021.01.004.
11. Writing Committee M, Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, Ganiats TG, Jessup M, Konstam MA, Mancini DM, Michl K, Oates JA, Rahko PS, Silver MA, Stevenson LW, Yancy CW, Antman EM, Smith SC, Adams CD, Anderson JL, Faxon DP, Fuster V, Halperin JL, Hiratzka LF, Hunt SA, Jacobs AK, Nishimura R, Ornato JP, Page RL, Riegel B. ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult. Circulation 2005;**112**(12):e154-e23510.1161/CIRCULATIONAHA.105.167586.
12. Ammar KA, Jacobsen SJ, Mahoney DW, Kors JA, Redfield MM, Burnett JC, Jr., Rodeheffer RJ. Prevalence and prognostic significance of heart failure stages: application of the American College of Cardiology/American Heart Association heart failure staging criteria in the community. Circulation 2007;**115**(12):1563-7010.1161/circulationaha.106.666818.
13. Young KA, Scott CG, Rodeheffer RJ, Chen HH. Progression of Preclinical Heart Failure: A Description of Stage A and B Heart Failure in a Community Population. Circ Cardiovasc Qual Outcomes 2021;**14**(5):e00721610.1161/circoutcomes.120.007216.

14. Xanthakis V, Enserro DM, Larson MG, Wollert KC, Januzzi JL, Levy D, Aragam J, Benjamin EJ, Cheng S, Wang TJ, Mitchell GF, Vasan RS. Prevalence, Neurohormonal Correlates, and Prognosis of Heart Failure Stages in the Community. JACC Heart Fail 2016;**4**(10):808-81510.1016/j.jchf.2016.05.001.
15. Mohebi R, Wang D, Lau ES, Parekh JK, Allen N, Psaty BM, Benjamin EJ, Levy D, Wang TJ, Shah SJ, Gottdiener JS, Januzzi JL, Jr., Ho JE. Effect of 2022 ACC/AHA/HFSA Criteria on Stages of Heart Failure in a Pooled Community Cohort. J Am Coll Cardiol 2023;**81**(23):2231-224210.1016/j.jacc.2023.04.007.
16. Dhingra R, Gaziano JM, Djoussé L. Chronic kidney disease and the risk of heart failure in men. Circ Heart Fail 2011;**4**(2):138-4410.1161/circheartfailure.109.899070.
17. He J, Shlipak M, Anderson A, Roy JA, Feldman HI, Kallem RR, Kanthety R, Kusek JW, Ojo A, Rahman M, Ricardo AC, Soliman EZ, Wolf M, Zhang X, Raj D, Hamm L. Risk Factors for Heart Failure in Patients With Chronic Kidney Disease: The CRIC (Chronic Renal Insufficiency Cohort) Study. J Am Heart Assoc 2017;**6**(5)10.1161/jaha.116.005336.
18. Waheed S, Matsushita K, Sang Y, Hoogeveen R, Ballantyne C, Coresh J, Astor BC. Combined Association of Albuminuria and Cystatin C–Based Estimated GFR With Mortality, Coronary Heart Disease, and Heart Failure Outcomes: The Atherosclerosis Risk in Communities (ARIC) Study. American Journal of Kidney Diseases 2012;**60**(2):207-216https://doi.org/10.1053/j.ajkd.2012.03.011.
19. Vaziri SM, Larson MG, Benjamin EJ, Levy D. Echocardiographic predictors of nonrheumatic atrial fibrillation. The Framingham Heart Study. Circulation 1994;**89**(2):724-3010.1161/01.cir.89.2.724.
20. Vinter N, Cordsen P, Johnsen SP, Staerk L, Benjamin EJ, Frost L, Trinquart L. Temporal trends in lifetime risks of atrial fibrillation and its complications between 2000 and 2022: Danish, nationwide, population based cohort study. Bmj 2024;**385**:e07720910.1136/bmj-2023-077209.
21. Gavaghan C. Pacemaker Induced Cardiomyopathy: An Overview of Current Literature. Curr Cardiol Rev 2022;**18**(3):e01092119602010.2174/2772432816666210901111616.
22. Tayal B, Fruelund P, Sogaard P, Riahi S, Polcwiartek C, Atwater BD, Gislason G, Risum N, Torp-Pedersen C, Kober L, Kragholm KH. Incidence of heart failure after pacemaker implantation: a nationwide Danish Registry-based follow-up study. Eur Heart J 2019;**40**(44):3641-364810.1093/eurheartj/ehz584.
23. Farouq M, Rorsman C, Marinko S, Mörtsell D, Chaudhry U, Wang L, Platonov P, Borgquist R. Risk factors and incidence of new-onset heart failure with conventional pacemaker implant: A nationwide study. Heart Rhythm O2 2024;**5**(9):623-63010.1016/j.hroo.2024.07.012.
24. Friday JM, Cleland JGF, Pellicori P, Wolters MK, McMurray JJV, Jhund PS, Forsyth P, McAllister DA, Graham FJ, Jones Y, Lewsey J. Loop diuretic therapy with or without heart failure: impact on prognosis. Eur Heart J 2024;**45**(37):3837-384910.1093/eurheartj/ehae345.
25. Bozkurt B, Ahmad T, Alexander KM, Baker WL, Bosak K, Breathett K, Fonarow GC, Heidenreich P, Ho JE, Hsich E, Ibrahim NE, Jones LM, Khan SS, Khazanie P, Koelling T, Krumholz HM, Khush KK, Lee C, Morris AA, Page RL, 2nd, Pandey A, Piano MR, Stehlik J, Stevenson LW, Teerlink JR, Vaduganathan M, Ziaeian B. Heart Failure Epidemiology and Outcomes Statistics: A Report of the Heart Failure Society of America. J Card Fail 2023;**29**(10):1412-145110.1016/j.cardfail.2023.07.006.
26. Gidding SS, Lloyd-Jones D, Lima J, Ambale-Venkatesh B, Shah SJ, Shah R, Lewis CE, Jacobs DR, Jr., Allen NB. Prevalence of American Heart Association Heart Failure Stages in Black and White Young and Middle-Aged Adults: The CARDIA Study. Circ Heart Fail 2019;**12**(9):e00573010.1161/circheartfailure.118.005730.
27. Shah AM, Claggett B, Loehr LR, Chang PP, Matsushita K, Kitzman D, Konety S, Kucharska-Newton A, Sueta CA, Mosley TH, Wright JD, Coresh J, Heiss G, Folsom AR, Solomon SD. Heart Failure Stages Among Older Adults in the Community: The Atherosclerosis Risk in Communities Study. Circulation 2017;**135**(3):224-24010.1161/circulationaha.116.023361.
28. Boutari C, Mantzoros CS. A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism

pandemic continues to rage on. Metabolism 2022;**133**:15521710.1016/j.metabol.2022.155217.
29. van Essen BJ, Emmens JE, Tromp J, Ouwerkerk W, Smit MD, Geluk CA, Baumhove L, Suthahar N, Gansevoort RT, Bakker SJL, Damman K, van der Meer P, de Boer RA, van Veldhuisen DJ, Voors AA. Sex-specific risk factors for new-onset heart failure: the PREVEND study at 25 years. European Heart Journal 2024;**46**(16):1528-153610.1093/eurheartj/ehae868 %J European Heart Journal.
30. Khan SS, Breathett K, Braun LT, Chow SL, Gupta DK, Lekavich C, Lloyd-Jones DM, Ndumele CE, Rodriguez CJ, Allen LA, on behalf of the American Heart Association Prevention Science Committee of the Council on E, Prevention, Council on C, Stroke N, Council on Basic Cardiovascular S, Council on Clinical C, Council on H, Council on Quality of C, Outcomes R. Risk-Based Primary Prevention of Heart Failure: A Scientific Statement From the American Heart Association. Circulation 2025;**151**(20):e1006-e102610.1161/CIR.0000000000001307.
31. Morbach C, Gelbrich G, Tiffe T, Eichner FA, Christa M, Mattern R, Breunig M, Cejka V, Wagner M, Heuschmann PU, Störk S, the Sc. Prevalence and determinants of the precursor stages of heart failure: results from the population-based STAAB cohort study. European Journal of Preventive Cardiology 2021;**28**(9):924-93410.1177/2047487320922636.
32. Conrad N, Judge A, Tran J, Mohseni H, Hedgecott D, Crespillo AP, Allison M, Hemingway H, Cleland JG, McMurray JJV, Rahimi K. Temporal trends and patterns in heart failure incidence: a population-based study of 4 million individuals. Lancet 2018;**391**(10120):572-58010.1016/s0140-6736(17)32520-5.
33. Roger VL. Epidemiology of Heart Failure. Circulation Research 2021;**128**(10):1421-143410.1161/CIRCRESAHA.121.318172.

Table 1. Characteristics of patients by heart failure stage in 2024

	Stage 0	**Stage A**	**Stage B**	**Stage C**	**Stage D**
	N = 6,516,385	N = 2,994,456	N = 886,952	N = 360,094	N = 26,474
Demographic characteristics					
Population proportion	60.4 %	27.8 %	8.2 %	3.3 %	0.2 %
Male sex	49.3 %	48.4 %	49.2 %	50.4 %	59.1 %
Age, mean ± SD	32 ± 20	56 ± 17	66 ± 17	76 ± 13	75 ± 12
Medical history					
Arterial hypertension	-	49.0 %	62.3 %	77.3 %	79.7 %
PCI/CABG	-	0.0 %	11.8 %	22.3 %	24.7 %
Atrial fibrillation	-	-	26.6 %	43.5 %	63.9 %
Stroke	-	1.8 %	5.3 %	8.2 %	9.2 %
Diabetes mellitus	-	20.9 %	30.4 %	52.4 %	74.0 %
CKD	-	3.6 %	8.4 %	22.3 %	43.2 %
Gastroduodenal ulcer disease	14.6 %	34.6 %	52.6 %	66.2 %	74.9 %
Asthma/COPD	16.5 %	21.0 %	27.3 %	36.1 %	44.5 %
Cancer in the last 5 years	0.9 %	4.7 %	8.5 %	10.4 %	10.0 %
Medication in 2024					
Digoxin (ATC C01AA05)	0.0 %	0.0 %	1.4 %	6.7 %	13.0 %
Furosemide (ATC C03CA01)	-	-	12.0 %	58.3 %	79.1 %

Spironolactone/eplerenone (ATC C03DA01, C03DA04)	-	-	8.5 %	39.8 %	62.0 %
Other diuretics (ATC C03 without C03CA01, C03DA01, C03DA04)	0.0 %	6.2 %	10.3 %	8.4 %	4.4 %
Beta-blockers (ATC C07)	0.2 %	19.7 %	45.3 %	68.5 %	80.1 %
Calcium channel blockers (ATC C08)	0.1 %	11.1 %	18.1 %	21.8 %	14.9 %
ARNI (ATC C09DX04)	-	-	-	5.6 %	24.3 %
ACE inhibitors/ARBs (ATC C09 without C09DX04)	0.5 %	53.9 %	61.4 %	66.8 %	49.7 %
Dapagliflozin/empagliflozin (ATC A10BK01, A10BK03)	0.0 %	2.3 %	5.9 %	23.5 %	50.8 %

CABG – coronary artery bypass graft, CKD – chronic kidney disease, COPD – chronic obstructive pulmonary disease, PCI – percutaneous coronary intervention, ARNI – angiotensin receptor/neprilysin inhibitor, ACEi – Angiotensin-converting enzyme inhibitors, AT2 – Angiotensin II receptor inhibitors

Table 2. Prevalence and time trends of heart failure stages

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Stage A	Absolute numbers	2,586,753	2,637,596	2,683,600	2,723,586	2,764,224	2,802,340	2,853,492	2,900,109	2,947,083	2,994,456
	Per 100,000 population	24,766	25,162	25,510	25,786	26,105	26,464	26,663	26,848	27,342	27,764
	Standardized to the 2013 ESP	24,413	24,706	24,956	25,143	25,363	25,620	25,827	26,085	26,432	26,723
Stage B	Absolute numbers	658,911	692,759	725,334	755,147	783,587	802,812	823,868	842,824	864,479	886,952
	Per 100,000 population	6,308	6,609	6,895	7,150	7,400	7,581	7,698	7,802	8,020	8,224
	Standardized to the 2013 ESP	6,425	6,644	6,839	7,010	7,177	7,266	7,364	7,452	7,562	7,657
Stage C	Absolute numbers	288,664	299,449	309,238	317,534	325,952	332,921	337,075	339,657	348,935	360,964
	Per 100,000 population	2,764	2,857	2,940	3,006	3,078	3,144	3,150	3,144	3,237	3,347
	Standardized to the 2013 ESP	2,948	2,998	3,025	3,042	3,062	3,068	3,062	3,043	3,067	3,101
Stage D	Absolute numbers	21,600	23,052	24,339	25,346	26,222	26,470	25,623	25,498	25,993	26,474
	Per 100,000 population	207	220	231	240	248	250	239	236	241	245
	Standardized to the 2013 ESP	218	228	236	241	245	242	231	228	228	227

ESP = European Standard Population

Table 3. Annual mortality by the heart failure stages

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Stage 0	Annual mortality	0.15 %	0.14 %	0.14 %	0.14 %	0.14 %	0.14 %	0.16 %	0.14 %	0.12 %	0.12 %
	Standardized to the 2013 ESP	0.62 %	0.58 %	0.59 %	0.55 %	0.53 %	0.60 %	0.64 %	0.55 %	0.47 %	0.45 %
Stage A	Annual mortality	1.09 %	1.04 %	1.05 %	1.07 %	1.04 %	1.18 %	1.33 %	1.09 %	0.99 %	0.97 %
	Standardized to the 2013 ESP	0.80 %	0.75 %	0.77 %	0.78 %	0.77 %	0.83 %	0.93 %	0.79 %	0.72 %	0.69 %
Stage B	Annual mortality	5.21 %	4.76 %	4.74 %	4.61 %	4.43 %	5.02 %	5.28 %	4.47 %	4.11 %	4.00 %
	Standardized to the 2013 ESP	2.27 %	2.03 %	2.03 %	1.99 %	1.90 %	2.06 %	2.24 %	1.94 %	1.74 %	1.69 %
Stage C	Annual mortality	11.00 %	10.41 %	10.60 %	10.51 %	10.35 %	11.92 %	12.31 %	10.69 %	9.79 %	9.49 %
	Standardized to the 2013 ESP	3.81 %	3.53 %	3.93 %	3.49 %	3.51 %	3.83 %	4.16 %	3.42 %	3.15 %	3.06 %
Stage D	Annual mortality	23.24 %	22.17 %	21.78 %	22.09 %	21.34 %	23.64 %	22.66 %	20.80 %	19.45 %	18.73 %
	Standardized to the 2013 ESP	8.54 %	11.88 %	9.38 %	9.23 %	9.19 %	9.74 %	8.48 %	8.29 %	7.89 %	7.27 %

ESP = European Standard Population

Figure 1: Distribution of heart failure stages in 2024 by age and sex

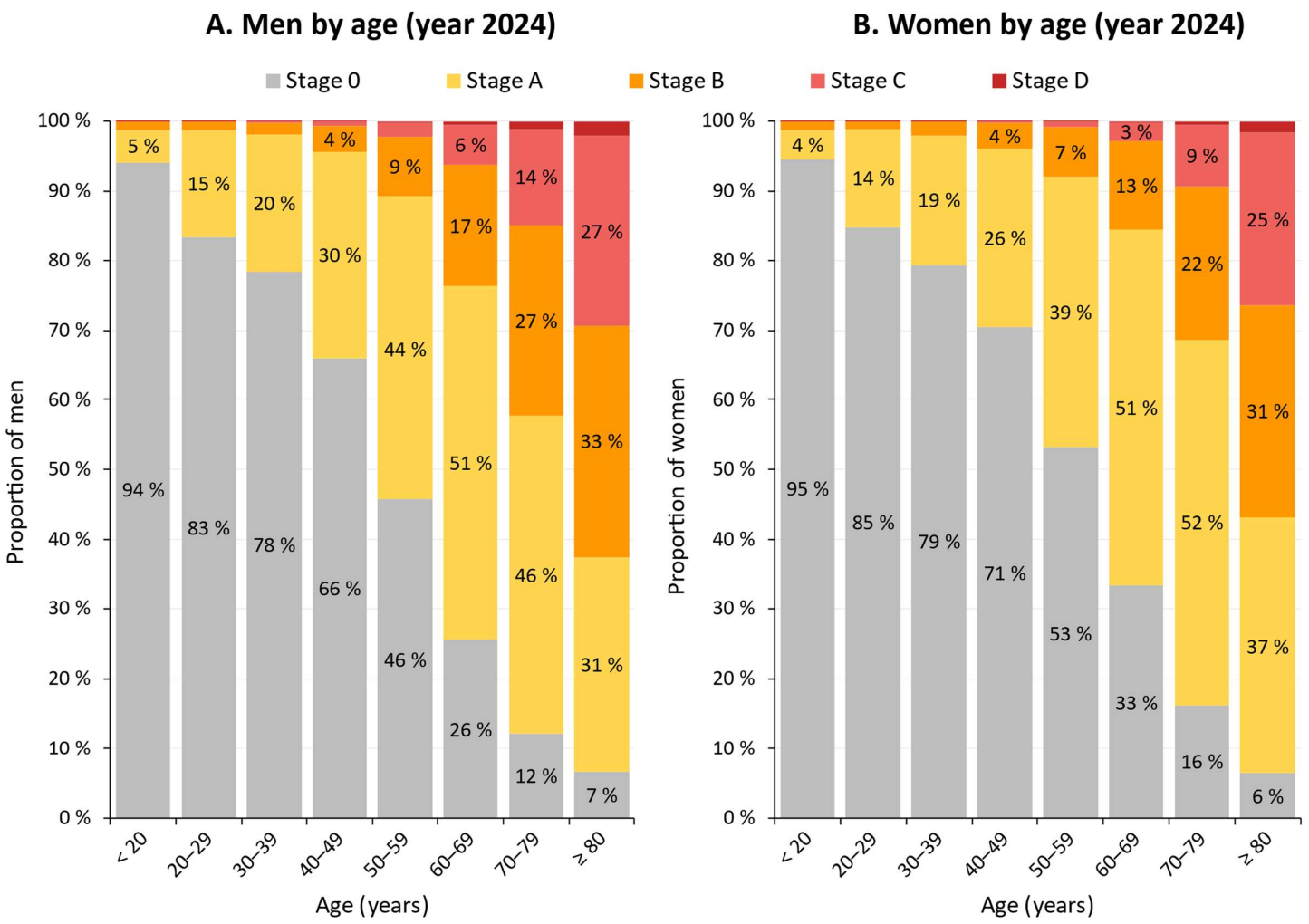


Figure 2: Transition of heart failure stages during the follow-up (2015-2024)

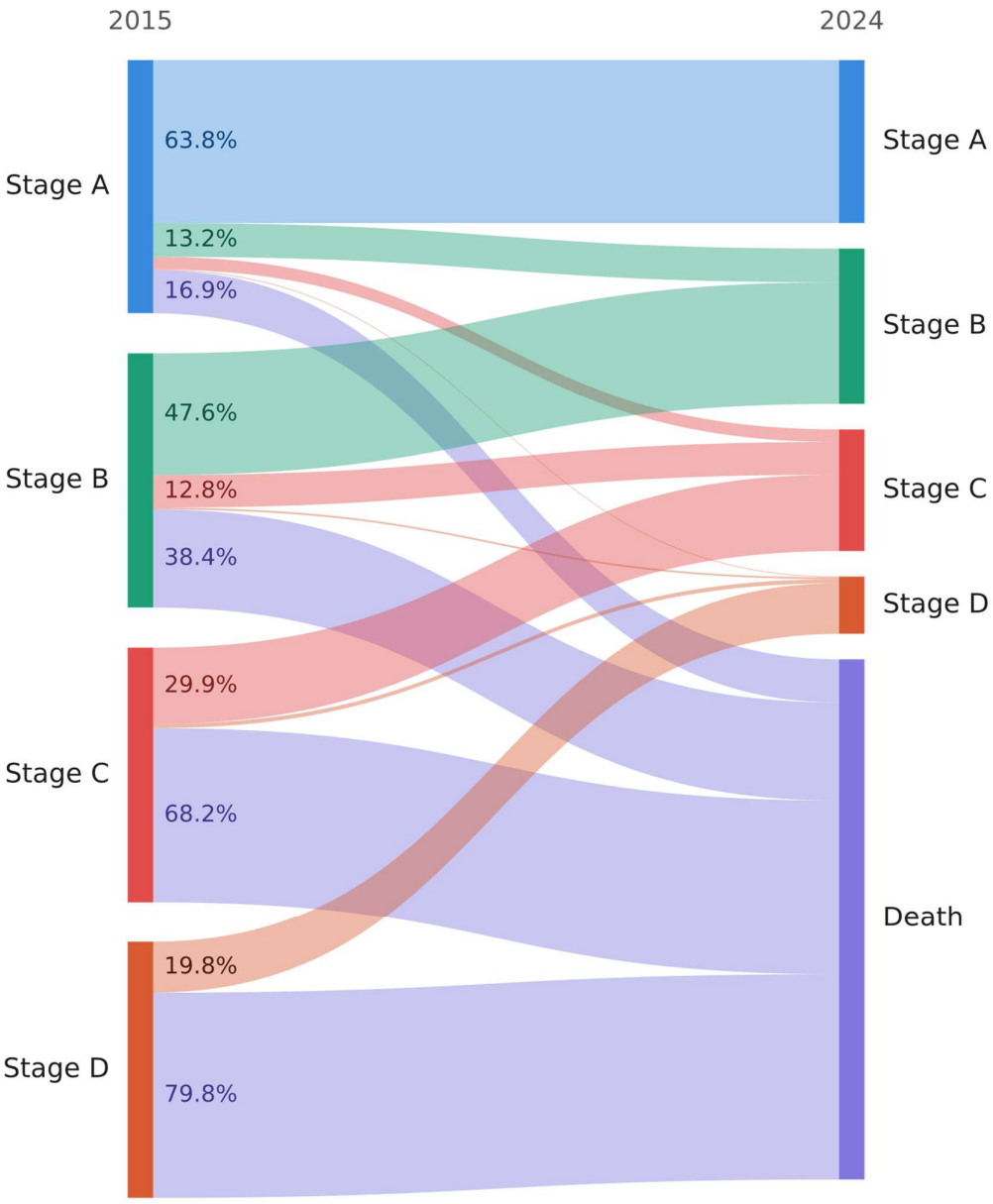


Figure 3: Mortality rate by heart failure stages in 2024

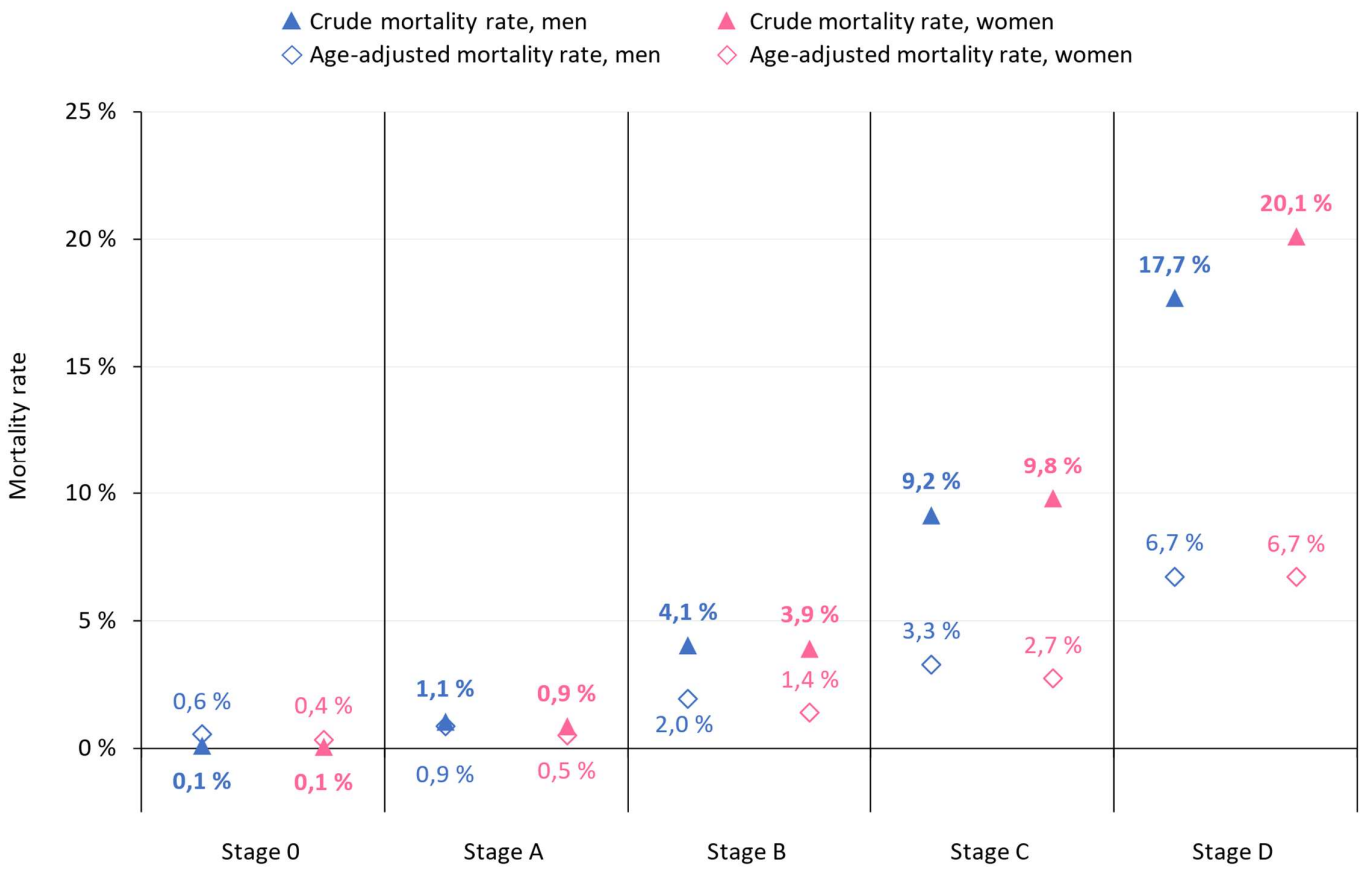
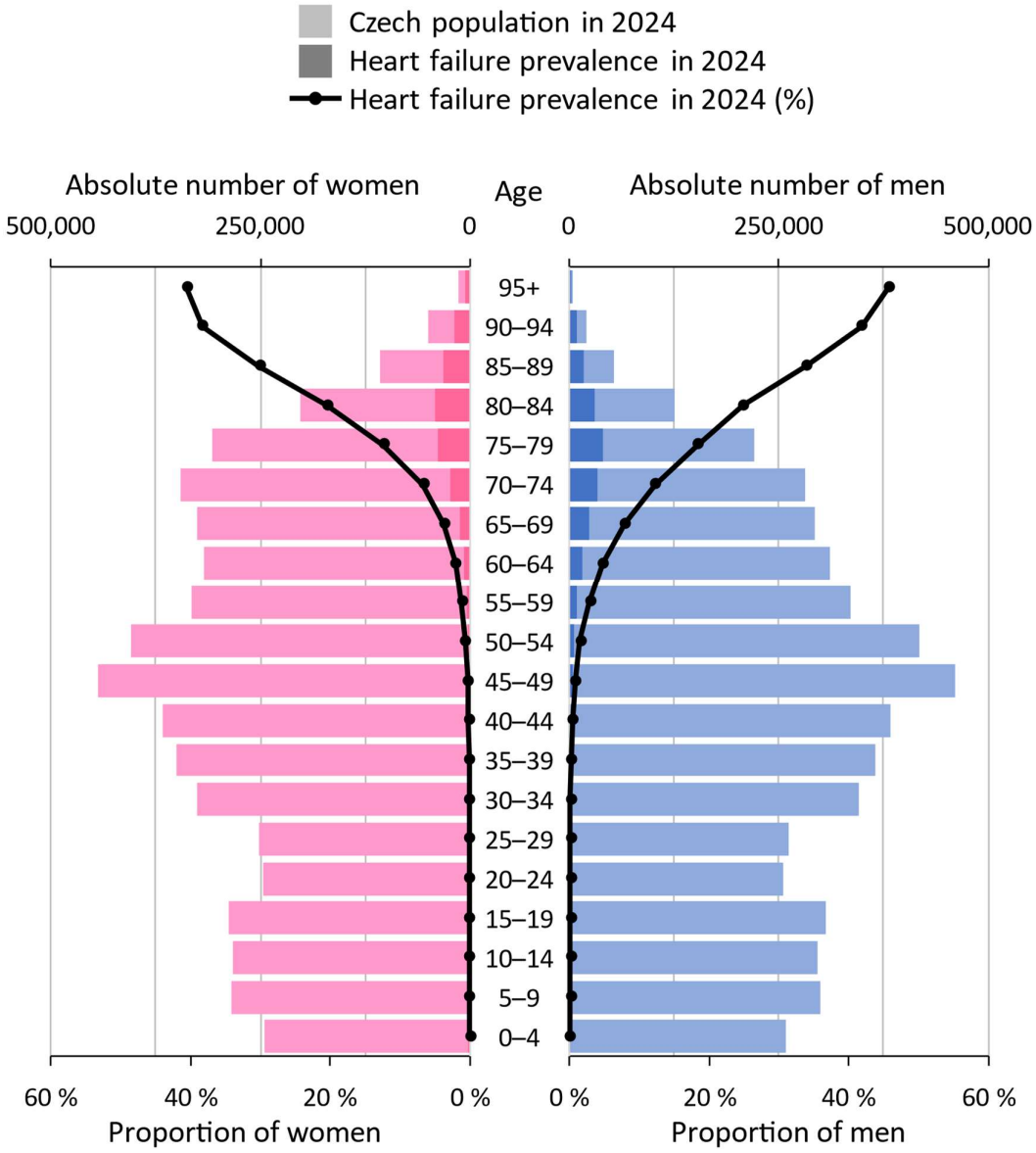


Figure 4: Age- and sex-specific distribution of clinical heart failure (Stages C and D) in the Czech population in 2024.



Supplementary Table 1: Definition of heart failure stages

Stage	Parameter	Definition
A	Arterial hypertension	At least two descriptions in a year of any ATC code C02 (antihypertensives), C03 (diuretics), C07 (beta blocking agents), C08 (calcium channel blockers), C09 (agents acting on the renin-angiotensin system), or C10BX (lipid modifying agents in combination with other drugs)
	Diabetes mellitus	ATC code A10 (drugs used in diabetes)
	Obesity	ICD-10 code E66 as a primary or secondary diagnosis reported by any healthcare provider
	Alcohol abuse	Any ICD-10 code E24.4, F10, G31.2, G62.1, I42.6, K70, K85.2, K86.0, T51, Z50.2, or Z71.4 as a primary or secondary diagnosis reported by any healthcare provider
	Chronic kidney disease	Any ICD-10 code I12.0, I13.1, I13.2, N03.2–7, N05.2–7, N18–N19, N25.0, Z49, Z94.0, or Z99.2 as a primary or secondary diagnosis reported by inpatient care providers or relevant outpatient specialists
	Stroke	ICD-10 code I63 or I64 as a primary inpatient diagnosis
	Cardiotoxic medication	ATC code L01DB (anthracyclines and related substances)
B	Atrial fibrillation	ICD-10 code I48 as a primary inpatient diagnosis
		ICD-10 code I48 as a secondary inpatient diagnosis or a primary diagnosis reported by relevant outpatient specialist plus any ATC code B01AA03 (warfarin), B01AE07 (dabigatran etexilate), B01AF01 (rivaroxaban), B01AF02 (apixaban), B01AF03 (edoxaban), C01BC03 (propafenone), or C01BD01 (amiodarone) within 90 days
		Catheter ablation or cardioversion procedure
	Selected cardiac diseases without heart failure-specific medication	Any ICD-10 code I05–I09, I11.0, I13.0, I13.2, I21–I25, I34–I37, I39, I40–I43, I50, Q20–Q24, or R57.0 as a primary or secondary inpatient diagnosis
		Any ICD-10 code I11.0, I13.0, I13.2, I25.5, I42.0, I42.9, I50, or R57.0 as a primary or secondary diagnosis reported by relevant outpatient specialists
	Pacemaker or implantable cardioverter-defibrillator	Implantation procedure & device
	Medication	ATC code C03CA01 (furosemide), C03DA01 (spironolactone), or C03DA04 (eplerenone)
C	Symptomatic heart failure	Any ICD-10 code I11.0, I13.0, I13.2, I25.5, I42.0, I42.9, I50, or R57.0 as a primary inpatient diagnosis
		Any ICD-10 code I05–I09, I11.0, I13.0, I13.2, I21–I25, I34–I37, I39, I40–I43, I50, Q20–Q24, or R57.0 as a secondary inpatient diagnosis or a primary diagnosis reported by relevant outpatient specialist plus

		any ATC code C03CA01 (furosemide), C03DA01 (spironolactone), C03DA04 (eplerenone), C09DX04 (valsartan and sacubitril) within 90 days
	Cardiac resynchronization therapy	Implantation procedure & device
	Medication	ATC code C09DX04 (valsartan and sacubitril)
D	Heart transplantation	Surgical procedure
	Left ventricular assist device	Implantation procedure & device
	Two hospital stays within a 365-day period, excluding transfers between facilities	Any ICD-10 code I11.0, I13.0, I13.2, I25.5, I42.0, I42.9, I50, or R57.0 as a primary inpatient diagnosis

Supplementary Table 2: Causes of death by heart failure stage among patients deceased in 2024

Chapters of ICD-10: causes of death	Stage 0	Stage A	Stage B	Stage C	Stage D
Number of death	7,759	28,971	35,482	34,259	4,958
I Certain infectious and parasitic diseases	1.5 %	1.8 %	2.2 %	2.7 %	2.5 %
II Neoplasms	34.5 %	31.5 %	28.1 %	16.7 %	9.4 %
III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	0.2 %	0.2 %	0.3 %	0.3 %	0.3 %
IV Endocrine, nutritional and metabolic diseases	1.3 %	4.4 %	5.0 %	6.7 %	6.5 %
V Mental and behavioral disorders	1.5 %	2.2 %	1.8 %	1.3 %	0.8 %
VI Diseases of the nervous system	6.7 %	5.4 %	4.2 %	2.8 %	0.9 %
IX Diseases of the circulatory system	21.5 %	29.9 %	35.8 %	48.1 %	60.2 %
X Diseases of the respiratory system	6.5 %	6.0 %	7.7 %	9.4 %	9.0 %
XI Diseases of the digestive system	3.1 %	5.4 %	6.2 %	3.7 %	2.6 %
XII Diseases of the skin and subcutaneous tissue	0.1 %	0.1 %	0.3 %	0.3 %	0.2 %
XIII Diseases of the musculoskeletal system and connective tissue	0.2 %	0.2 %	0.3 %	0.3 %	0.2 %
XIV Diseases of the genitourinary system	0.7 %	1.2 %	1.8 %	2.7 %	3.2 %
XVI Certain conditions originating in the perinatal period	1.2 %	0.0 %	0.0 %	0.0 %	0.0 %
XVII Congenital malformations, deformations and chromosomal abnormalities	0.7 %	0.1 %	0.1 %	0.1 %	0.1 %
XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	5.9 %	3.3 %	2.2 %	1.9 %	1.6 %
XIX Injury, poisoning and certain other consequences of external causes	14.0 %	7.7 %	3.4 %	2.2 %	1.7 %
XXII Codes for special purposes	0.4 %	0.5 %	0.7 %	0.8 %	0.7 %

Supplementary table 3: Transition of heart failure stages during the follow-up

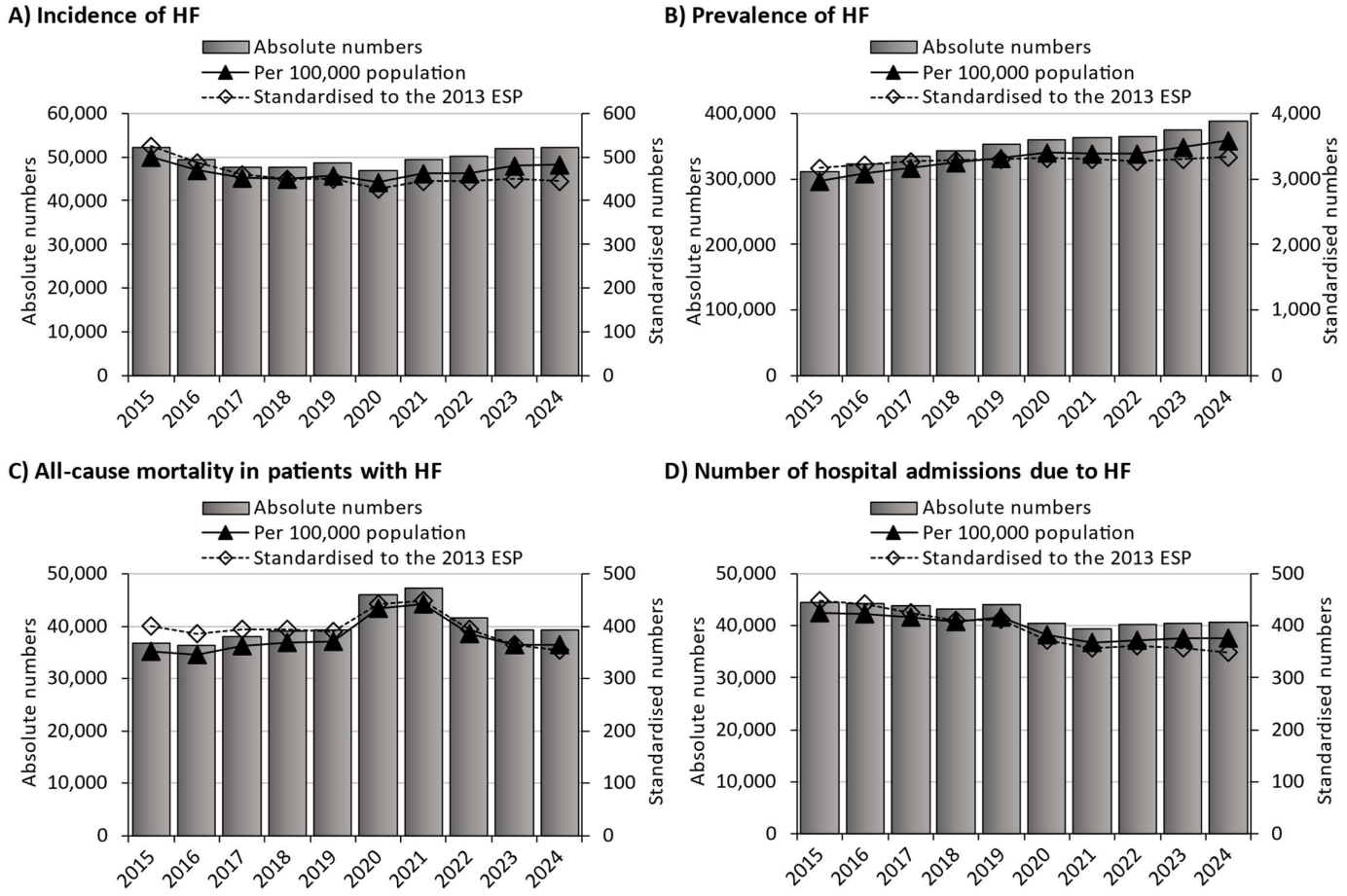
		Heart Failure Stage as of 31 December 2024						
		0	**A**	**B**	**C**	**D**	**Death**	**Lost to follow-up**
Heart Failure Stage as of 31 December 2015	**0**	72.7 %	18.0 %	2.8 %	0.6 %	0.04 %	2.6 %	3.3 %
	A	-	63.8 %	13.2 %	4.9 %	0.3 %	16.9 %	0.8 %
	B	-	-	47.6%	12.8 %	0.7 %	38.4 %	0.5 %
	C	-	-	-	29.9 %	1.6 %	68.2 %	0.3 %
	D	-	-	-	-	19.8 %	79.8 %	0.3 %

Table 4. Epidemiology of clinical heart failure stages (stage C+D)

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Incidence	Absolute numbers	52,171	49,292	47,599	47,568	48,534	46,835	49,462	50,042	51,796	52,172
	Per 100,000 population	499.5	470.2	452.5	450.4	458.4	442.3	462.2	463.3	480.7	483.7
	Standardized to the 2013 ESP	526.2	488.0	460.2	449.8	450.3	426.9	444.3	444.1	450.8	444.4
Prevalence	Absolute numbers	310,264	322,501	333,577	342,880	352,174	359,391	362,698	365,155	374,928	387,438
	Per 100,000 population	2,970	3,077	3,171	3,246	3,326	3,394	3,389	3,380	3,478	3,592
	Standardized to the 2013 ESP	3,166	3,226	3,261	3,282	3,307	3,311	3,293	3,271	3,295	3,328
Mortality	Absolute numbers	36,779	36,287	38,072	38,981	39,342	45,928	47,298	41,615	39,209	39,217
	Per 100,000 population	352.1	346.2	361.9	369.1	371.5	433.7	442.0	385.2	363.8	363.6
	Standardized to the 2013 ESP	400.1	384.8	394.0	393.6	389.2	443.3	449.1	394.3	363.5	353.2

ESP = European Standard Population

Supplementary Figure 1: Incidence, prevalence, all-cause mortality, and hospital admissions for heart hart failure between 2015-2024.



Supplementary Figure 2: Trends in heart failure stages