Global epidemiology and future trends of heart failure

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Abstract: Some population statistics suggested that the epidemiologic burden of heart failure (HF) may have significantly decreased between 2000 and 2010. However, this trend could not be confirmed in other continental or nationwide surveys. We aimed to provide an objective and concise analysis of the worldwide epidemiological burden of HF. An electronic search was performed in Global Health Data Exchange (GHDx) registry, with the keyword "heart failure". The current worldwide prevalence of HF is 64.34 million cases (8.52 per 1,000 inhabitants), accounting for 9.91 million years lost due to disability (YLDs) and 346.17 billion US $ expenditure. YLDs value is marginally higher in men. HF poses the largest burden after 60 years of age and both prevalence and YLDs have increased by 3.9% and 4.5% in very elderly people during the last 28 years. A linear, direct relationship can be found between socio-demographic index (SDI) and both prevalence and YLDs of HF. HF is an emerging worldwide threat whose prevalence and health loss burden constantly increase, especially in the elderly and in people leaving in low-to middle SDI regions. Urgent preventive interventions shall be prioritized and healthcare resources redesigned around this evolving epidemiology.

Keywords: Heart failure (HF); heart disease; health; epidemiology; mortality

Introduction

Irrespective of the underlying cause, heart failure (HF) generates an enormous clinical, societal and economic burden. Although some population statistics suggested that the epidemiologic burden of HF may have significantly decreased between 2000 and 2010 (1), this trend could not be confirmed in other continental or nationwide surveys, which showed instead that both the incidence and prevalence of HF may be increasing especially due to a constantly growing proportion of population aged 70 years or older (2-5). Accurate assessment of epidemiologic trends is vital for optimizing healthcare resources allocation in a world still plagued by an unprecedented economic crisis (6). Therefore, in this brief report, we aimed to provide an objective and concise analysis of the worldwide epidemiological burden of HF, providing also an estimation of possible future trends.

Methods

An electronic search was performed in the Global Health Data Exchange (GHDx) registry, a large database of health-related data maintained by the Institute for Health Metrics and Evaluation (7), using the keyword "heart failure" [International Classification of Diseases 10 (ICD-10) Code I50] in the category "impairment" combined with "all causes" in the category "cause". According to the Global Burden of Disease (GBD) Collaborators, HF clinically diagnosed, using structured criteria such as those of Framingham or the European Society of Cardiology (ESC) (8,9). Mild HF was then defined as shortness of breath and fatigue with moderate physical activity such as walking uphill or more than a quarter-mile on level ground (disability weight, 0.041; 95% confidence interval (CI), 0.026–0.062), moderate HF as is shortness of breath and easy fatigue with minimal
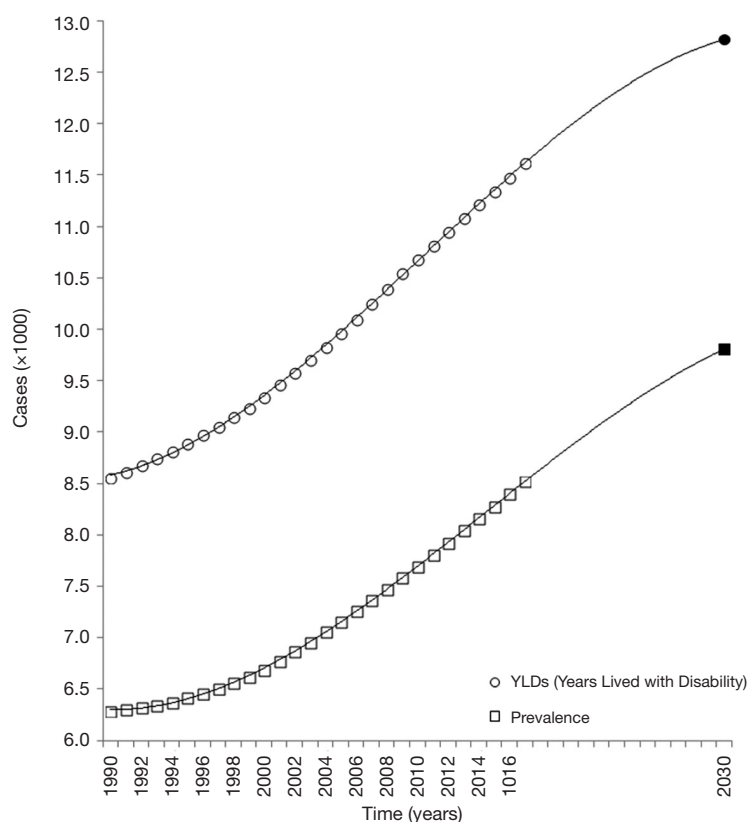
Figure 1 Last 28-year trend and current scenario of worldwide epidemiology of HF.

physical activity such as walking a short distance (disability weight, 0.072; 95% CI, 0.047–0.103), whilst severe HF was defined as shortness of breath and fatigue even at rest (disability weight, 0.179; 95% CI, 0.122–0.251) (10). The years lost due to disability (YLDs) was considered the indicator of disease or risk factor attributable to health loss, reflecting the burden of living with a certain disease or disability. The database search was then combined with the epidemiologic variables "year", "sex", "age" and "location" (using "SDI Regions", where SDI stands for socio-demographic index).

The output of the electronic search was downloaded in comma-separated values (CSV), imported into an Excel file (Microsoft, Redmond, WA, USA) and analyzed with Analyse-it (Analyse-it Software Ltd, Leeds, UK) and MedCalc statistical software (MedCalc Software, Ostend, Belgium). Simple (Pearson's correlation) regression analyses were used for assessing potential associations (and their relative 95% CI) among different epidemiologic measures, whilst the risk was expressed as odds ratio (OR) and relative 95% CI. The study was performed in accordance with the Declaration of Helsinki and under the terms of relevant local legislation.

Results

According to the last searchable GDHx period (i.e., year 2017), the current worldwide prevalence of HF is estimated at 64.34 million cases (8.52 per 1,000 inhabitants, 29% of which mild, 19% moderate and 51% severe HF), accounting for 9.91 million YLDS (11.61 per 1,000 YLDs). Based on an American Heart Association (AHA) estimation of 5380 US $ per HF case (11), the current worldwide economic burden of HF can be estimated at 346.17 billion US $. The most frequent causes of HF with known etiology is ischemic heart disease (42.3% of all cases), followed by chronic obstructive pulmonary disease (37.0%), mitral valve disease (4.3%), aortic valve disease (3.4%), rheumatic heart disease (3.0%), myocarditis (2.6%) and endocarditis (1.4%). The last 28-year trend (i.e., between the years 1990 to 2017) is shown in *Figure 1*. A considerable increase has occurred for both prevalence and YLDs of HF, both trends perfectly

matching a third-degree polynomial equation (r=1.000 and P<0.001 for both). Overall, prevalence and YLDs of HF have increased by ~36% since the year 1900, and this trend is not likely to reverse soon. According to estimations based on the third-degree polynomial equations, prevalence and YLDs will probably grow to 9.81 per 1,000 inhabitants (+15.1%) and 12.82 per 1,000 YLDs (+10.4%) by the year 2030, accounting for ~398.44 billion US $ worldwide expenditure.

Although the prevalence of HF appears significantly higher in the female sex (9.16 *vs.* 7.69 per million inhabitants; OR, 1.19; 95% CI, 1.18–1.20; P<0.001), the value of YLDs is instead marginally but significantly higher in men than in women (11.74 *vs.* 11.50 per 1,000 YLDs; OR, 1.02; 95% CI, 1.01–1.03; P<0.001). Both prevalence and YLDs have remained almost constant between genders during the last 28 years. The current and last 28-year trend of prevalence and YLDs of HF in different age groups are shown in *Figure 2A*. Overall, HF poses the largest burden after 60 years of age (81% and 87% of all HF cases and all YLDs for HF, respectively). The risk of developing HF is over 20-fold higher in people aged ≥60 years than in younger subjects (OR: 21.9; 95% CI, 21.8–22.0; P<0.001). Importantly, the prevalence and YLDs of HF have increased by 3.9% and 4.5% in very elderly people (i.e., aged ≥80 years) during the last 28 years. The burden of HF in the different SDI areas is finally shown in *Figure 2B*. A linear, direct relationship can be found between SDI and both prevalence (r=0.94, 95% CI, 0.31–1.00; P=0.019) or YLDs (r=0.92; 95% CI, 0.20–0.99; P=0.027) of HF.

Though the burden of HF remains higher in high SDI regions (31% of all HF cases and 28% of all YLDs for HF), the 28-year trends reveal a –11.2% decreased prevalence in these regions counterbalanced by a 10.3% increase in low-to-middle SDI regions. The YLDs trend is very similar, with a 10.5% decline in high SDI regions occurred during the last 28 years, counterbalanced by a 10.0% increment in low-to-middle SDI regions. The last 10-year trend of HF prevalence seems virtually linear both in high SDI (r=0.999; P<0.001) and low-to-middle SDI (r=1.000; P<0.001) regions (*Figure 3*). By the year 2030, it can hence be estimated that the prevalence of HF will increase over 50% in low-to-middle SDI regions, whilst it will decline to ~27% in high SDI countries, respectively.

Discussion

Although evidence has been provided that the epidemiologic impact of HF may have decreased during the past decades (1), more recently published continental or nationwide studies showed an almost opposite trend (2-5). The results of our analysis suggest that both prevalence and health loss (i.e., YLDs) of HF have constantly increased during the past 28 years on a worldwide scale, following a path that is unlikely to reverse in the next 10 years based on our estimations. The recent AHA projections show that the prevalence of HF in the US will probably increase from 2.42% in 2012 to 2.97% in 2030 (11), exhibiting a relative increment of 22.7% that would perfectly overlap the increment of worldwide prevalence predicted by our estimation during the same period of time (7.93 per 1,000 inhabitants in 2012 *vs.* 9.81 per 100 inhabitants in 2030, +23.7%) (*Figure 1*). Notably, this increased population burden will then translate into an enhanced worldwide expenditure for managing HF patients, which will reach approximately 400 billion US $ in 2030, thus approximating the gross domestic product of an entire country like Austria, Ireland or Israel. Although the sex distribution of HF has not apparently changed during the last 28 years, with prevalence constantly higher in the female sex and YLDs slightly larger in men, the impact of HF in different age ranges has instead significantly varied, with an ~4% increase in the very elderly population, as possible reflection of worldwide population ageing. This increment has been almost constant and has even sharpened during the last 10 years (+ ~2%; *Figure 2A*), which would hence lead us to estimate that both prevalence and YLDs will consistently increase over 30% in people aged ≥80 years by the year 2030. Since the higher inpatient costs for managing HF are those resulting from hospital readmissions (12), which are up to 4-fold higher in the elderly (13), it is hence very likely that the epidemic proportion reached by HF in older individuals may consistently amplify the usage of healthcare resource for managing HF in the next 10 years.

The last 28-year trend and the current socioeconomic distribution of HF around the world deserve special focus. Although the burden of HF is still largely prevalent in middle-to-high SDI regions, the recent trend shows that the distribution may soon change (*Figure 2B*). More specifically, our analysis shows that the burden of HF has increased by 3.1% in the last 10 years in low-to-middle SDI regions (from 43.4% to 46.5% of all worldwide HF cases), which would allow us to estimate that the burden of this condition will overcome 50% by the year 2030, thus reversing the current scenario where HF is more prevalent in middle-
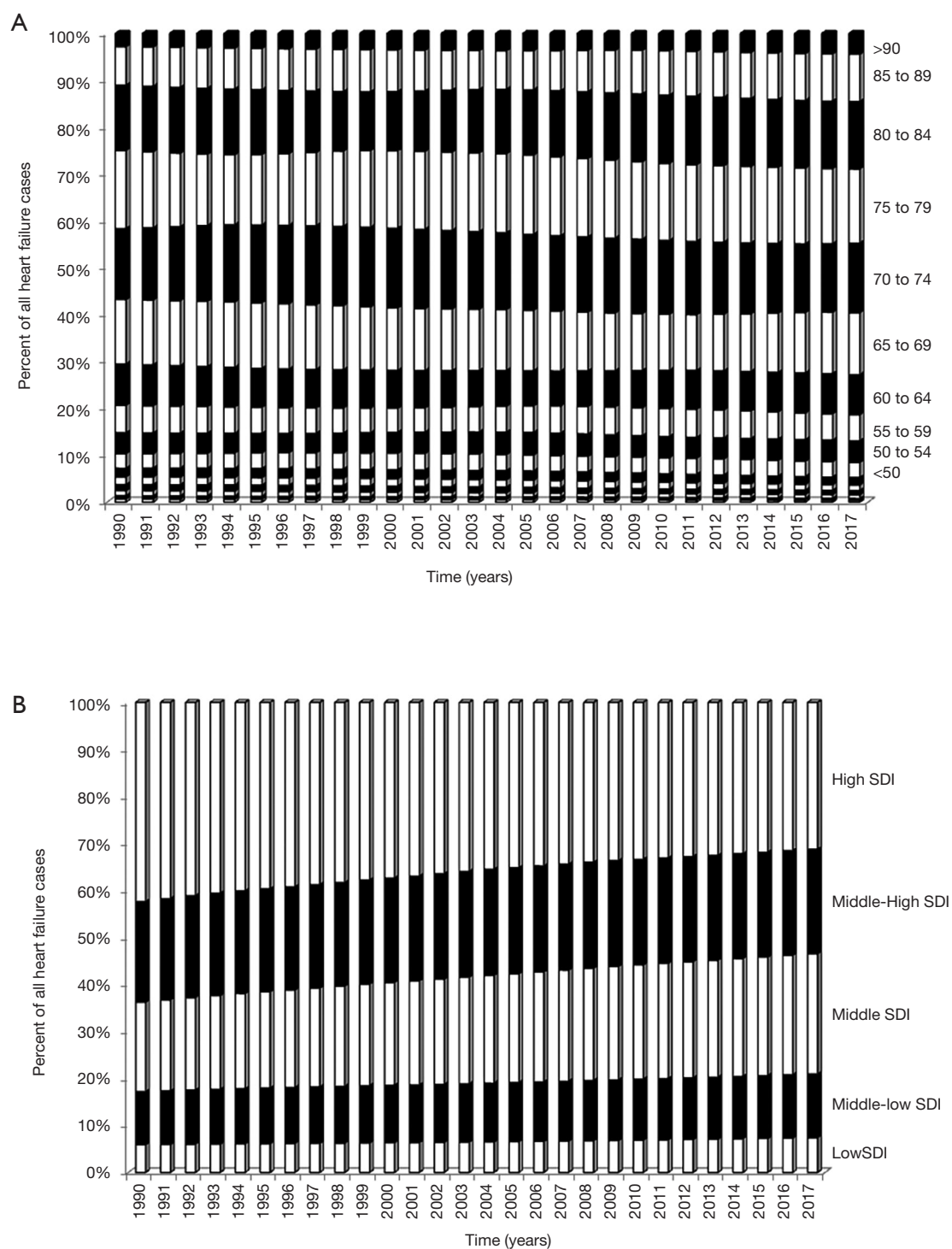
Figure 2 Global trends on HF during the last 28 years. (A) Last 28-year trend and current scenario of worldwide epidemiology of HF in different age ranges; (B) last 28-year trend and current scenario of worldwide epidemiology of HF in different SDI regions. HF, heart failure; SDI, socio-demographic index.
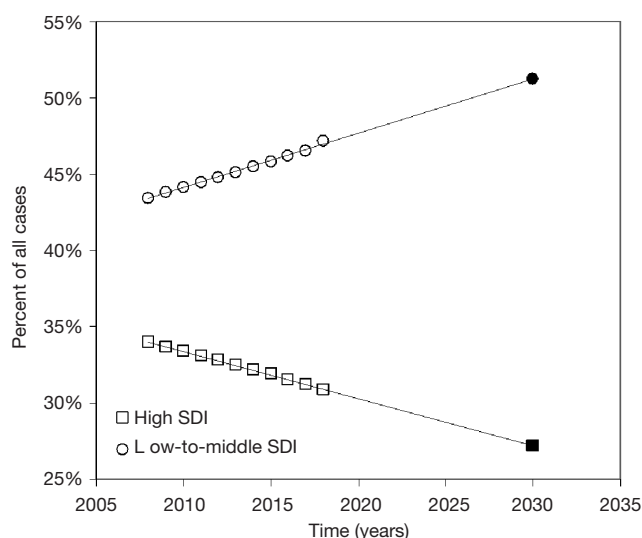
Figure 3 Current and future trends of HF prevalence in middle-to-low and high SDI regions. HF, heart failure; SDI, socio-demographic index.

to-high SDI countries (*Figure 3*). This prediction will pose additional challenges, whereby HF in low-income countries is clinically different from Europe and North America and its outcome is dramatically influenced by worse healthcare infrastructure availability, as well as by lower care access and quality (14). This will require definition and implementation of highly tailored healthcare measures that may pose a theoretically unsustainable burden on local healthcare systems in these countries (15).

Conclusions

The results of our analysis attest that HF is an emerging worldwide threat whose prevalence and health loss burden are constantly increasing, especially in the elderly and in people leaving in low SDI regions. Urgent interventions shall hence be prioritized and scaled up for targeting the cause of HF and preventing its onset and worsening, as well as for redesigning healthcare access, infrastructure and therapies around this evolving epidemiology.

Acknowledgments

Footnote

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