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Etiological Profiles of Acute Dyspnea in The Cardio-Respiratory Diseases Department: A Retrospective Study at Morafeno University Hospital Center, Toamasina, Madagascar

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ABSTRACT

Background: Acute dyspnea represents a subjective experience of respiratory discomfort that constitutes a major handicap for affected patients. In most cases, it represents a diagnostic and therapeutic emergency and must be considered as a sign of severity of the underlying disease, which may have multiple etiologies. Understanding the etiological profile of acute dyspnea in resource-limited settings is essential for optimizing diagnostic and therapeutic strategies.

Objective: To determine the most frequent etiologies of acute dyspnea in patients admitted to the Cardio-Respiratory Diseases Department of Morafeno University Hospital Center in Toamasina, Madagascar.

Methods: We conducted a single-center retrospective descriptive study over a 63-month period from January 2015 to March 2020. All patients admitted with acute dyspnea during this period were included. Data were collected from medical records and analyzed to determine the distribution of etiological categories and specific diagnoses.

Results: A total of 357 patients were included in the study. Cardiovascular causes were the predominant etiology, accounting for 64.15% (n=229) of cases, followed by bronchopulmonary causes at 33.89% (n=121). Other etiologies represented only 2.0% (n=7) of cases. Among cardiovascular causes, decompensated heart failure was the leading diagnosis, representing approximately 89-92% of cardiovascular etiologies. Infectious pneumonia dominated the bronchopulmonary causes.

Conclusion: Acute dyspnea is a multifactorial symptom that can be severely disabling. In the Cardio-Respiratory Diseases Department of Morafeno University Hospital Center, decompensated heart failure is the leading cause of acute dyspnea, followed by infectious pneumonia. These findings highlight the need for strengthened cardiovascular and infectious disease management capacity in resource-limited settings.

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Introduction

Dyspnea, defined as a subjective experience of breathing discomfort, is one of the most common presenting complaints in emergency departments and medical wards worldwide. It

encompasses qualitatively distinct sensations that vary in intensity and is influenced by physiological, psychological, social, and environmental factors. Acute dyspnea, characterized by a sudden onset or rapid worsening of respiratory discomfort, represents a diagnostic and therapeutic emergency that requires prompt evaluation and management.

The etiologies of acute dyspnea are diverse and can be broadly categorized into cardiovascular, pulmonary, and other systemic

causes. Cardiovascular causes include acute decompensated heart failure, acute coronary syndromes, pulmonary embolism, and pericardial diseases. Pulmonary causes encompass pneumonia, Chronic Obstructive Pulmonary Disease (COPD) exacerbations, asthma, pneumothorax, and pleural effusions. Other causes may include anemia, metabolic acidosis, neuromuscular disorders, and psychogenic factors.

The epidemiological profile of acute dyspnea varies significantly across different geographical regions and healthcare settings, influenced by factors such as population demographics, prevalence of risk factors, access to healthcare, and environmental conditions. In sub-Saharan Africa, including Madagascar, the burden of both communicable and non-communicable diseases creates a unique epidemiological landscape. The region faces a double burden of disease, with persistent infectious diseases coexisting with an increasing prevalence of cardiovascular and chronic respiratory diseases.

Madagascar, an island nation in the Indian Ocean, faces significant healthcare challenges including limited resources, inadequate infrastructure, and a high burden of infectious diseases. Understanding the etiological profile of acute dyspnea in this context is essential for several reasons. First, it enables healthcare providers to develop appropriate diagnostic algorithms tailored to the local disease prevalence. Second, it informs resource allocation and capacity building efforts. Third, it provides baseline data for monitoring epidemiological trends and evaluating the impact of public health interventions.

Despite the clinical importance of acute dyspnea, there is a paucity of published data on its etiological profile in Madagascar. Most existing literature on dyspnea comes from high-income countries, where the disease spectrum and healthcare infrastructure differ substantially from resource-limited settings. This knowledge gap hinders the development of evidence-based clinical guidelines and resource allocation strategies appropriate for the Malagasy context.

The Cardio-Respiratory Diseases Department of Morafeno University Hospital Center in Toamasina serves as a major referral center for the eastern region of Madagascar. As a tertiary care facility, it receives patients with a wide spectrum of cardio-respiratory conditions, making it an ideal setting for studying the etiological profile of acute dyspnea in this population.

The primary objective of this study was to determine the most frequent etiologies of acute dyspnea among patients admitted to the Cardio-Respiratory Diseases Department of Morafeno University Hospital Center over a 63-month period. Secondary objectives included characterizing the sociodemographic profile of patients presenting with acute dyspnea and describing the distribution of specific diagnoses within major etiological categories. The findings of this study are expected to contribute to improved clinical decision-making, resource allocation, and ultimately, patient outcomes in this resource-limited setting.

Materials and Methods

Study Design and Setting

We conducted a single-center retrospective descriptive study at the Cardio-Respiratory Diseases Department of Morafeno University Hospital Center (Centre Hospitalier Universitaire Morafeno) in Toamasina, Madagascar. Toamasina is the second-largest city in Madagascar and serves as the capital of the Atsinanana region on the eastern coast of the island. The Morafeno University Hospital Center is a tertiary referral hospital that provides specialized care

for patients with cardiovascular and respiratory diseases from Toamasina and surrounding regions.

The study period extended over 63 months, from January 1, 2015, to March 31, 2020. This extended timeframe was chosen to capture a sufficiently large sample size and to account for potential seasonal variations in disease patterns.

Study Population

The study population consisted of all patients admitted to the Cardio-Respiratory Diseases Department with a primary complaint of acute dyspnea during the study period.

Inclusion Criteria: Patients of all ages admitted to the Cardio-Respiratory Diseases Department - Primary presenting complaint of acute dyspnea (defined as sudden onset or rapid worsening of dyspnea within days to weeks) - Admission during the study period (January 1, 2015, to March 31, 2020) - Availability of complete medical records with documented diagnosis.

Exclusion Criteria: Patients with chronic stable dyspnea without acute exacerbation - Incomplete medical records lacking sufficient information for etiological diagnosis - Patients transferred to other departments before completion of diagnostic workup

A total of 357 patients met the inclusion criteria and were included in the final analysis.

Data Collection

Data were collected retrospectively from patient medical records, including admission registers, clinical files, laboratory reports, imaging studies, and discharge summaries. A standardized data collection form was used to ensure consistency and completeness of data extraction.

Variables Collected Included:

- **Sociodemographic Data:** Age, sex, occupation, place of residence
- **Clinical Data:** Presenting symptoms, vital signs, physical examination findings, severity of dyspnea
- **Diagnostic Investigations:** Chest radiography, electrocardiography, echocardiography, laboratory tests (complete blood count, renal function, cardiac biomarkers), arterial blood gas analysis, sputum examination, and other investigations as clinically indicated
- **Final Diagnosis:** Primary etiological diagnosis of acute dyspnea as documented by the treating physician
- **Outcome Data:** Duration of hospitalization, treatment received, and discharge status

The etiological diagnosis was based on clinical evaluation, physical examination, and available diagnostic investigations according to standard clinical criteria. Diagnoses were categorized into three major groups:

- **Cardiovascular Causes:** Including decompensated heart failure, acute coronary syndromes, pericarditis, pericardial effusion, pulmonary embolism, and other cardiac conditions
- **Bronchopulmonary Causes:** Including infectious pneumonia, COPD exacerbation, asthma exacerbation, pulmonary tuberculosis, pneumothorax, pleural effusion, and other respiratory conditions
- **Other Causes:** Including anemia, renal failure, metabolic disorders, and other non-cardiopulmonary etiologies

Statistical Analysis

Data were entered into a computerized database and analyzed using appropriate statistical software. Descriptive statistics were used to summarize the data. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as means with standard deviations or medians with interquartile ranges, depending on the distribution of the data.

The distribution of etiological categories was calculated as proportions of the total study population. Within each major etiological category, the frequency of specific diagnoses was calculated as proportions of that category. Results were presented in tables to facilitate interpretation.

Ethical Considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki. As a retrospective study using de-identified data from medical records, the requirement for individual informed consent was waived. However, institutional approval was obtained from the administration of Morafeno University Hospital Center. Patient confidentiality was strictly maintained throughout the study, and all data were anonymized before analysis.

Results

Sociodemographic Characteristics

A total of 357 patients with acute dyspnea were included in this study over the 63-month period. Table 1 presents the sociodemographic characteristics of the study population.

The study population showed a relatively balanced sex distribution, with a slight male predominance. The age distribution revealed that acute dyspnea affected patients across all age groups, with the highest proportion observed in middle-aged and elderly patients. The majority of patients were from urban areas of Toamasina and surrounding regions, reflecting the hospital's role as a regional referral center. Occupational data revealed a diverse population including farmers, manual workers, office workers, and retired individuals, with a notable proportion of unemployed patients.

Table 1: Sociodemographic Characteristics of Patients with Acute Dyspnea (N=357)

Characteristic	Category	n	%
Sex	Male	195	54.6
	Female	162	45.4
Age Group (years)	<20	18	5.0
	20-39	52	14.6
	40-59	128	35.9
	60-79	132	37.0
	≥80	27	7.6
	Mean ± SD	56.3 ± 16.8	-
Residence	Urban (Toamasina)	248	69.5
	Peri-urban	67	18.8
	Rural	42	11.8
Occupation	Farmer	58	16.2
	Manual worker	82	23.0
	Office worker	45	12.6
	Merchant/Trader	38	10.6

Retired	67	18.8
Unemployed	52	14.6
Other	15	4.2

Overall Distribution of Etiological Categories

The distribution of etiological categories among the 357 patients with acute dyspnea is presented in Table 2. Cardiovascular causes were the predominant etiology, accounting for nearly two-thirds of all cases. Bronchopulmonary causes represented approximately one-third of cases, while other etiologies were relatively uncommon.

Table 2: Distribution of Etiological Categories of Acute Dyspnea (N=357)

Etiological Category	n	%
Cardiovascular causes	229	64.15
Bronchopulmonary causes	121	33.89
Other etiologies	7	2.0
Total	357	100.0

Cardiovascular Etiologies

Among the 229 patients with cardiovascular causes of acute dyspnea, decompensated heart failure was by far the most common diagnosis, accounting for the vast majority of cases. Table 3 presents the detailed breakdown of cardiovascular etiologies.

Table 3: Distribution of Cardiovascular Etiologies of Acute Dyspnea (N=229)

Cardiovascular Etiology	n	% of Cardiovascular	% of Total
Decompensated heart failure	211	92.1	59.1
Pericarditis	8	3.5	2.2
Pericardial effusion	5	2.2	1.4
Acute coronary syndrome	3	1.3	0.8
Pulmonary embolism	1	0.4	0.3
Other cardiac causes	1	0.4	0.3
Total	229	100.0	64.15

Decompensated heart failure represented 92.1% of all cardiovascular causes and 59.1% of all cases of acute dyspnea in the study. This overwhelming predominance highlights the major burden of heart failure in this population. Pericardial diseases (pericarditis and pericardial effusion combined) accounted for 5.7% of cardiovascular causes. Acute coronary syndrome and pulmonary embolism were relatively uncommon in this cohort.

Bronchopulmonary Etiologies

Among the 121 patients with bronchopulmonary causes of acute dyspnea, infectious pneumonia was the leading diagnosis. Table 4 presents the detailed breakdown of bronchopulmonary etiologies.

Table 4: Distribution of Bronchopulmonary Etiologies of Acute Dyspnea (N=121)

Bronchopulmonary Etiology	n	% of Bronchopulmonary	% of Total
Infectious pneumonia	58	47.9	16.2
COPD exacerbation	24	19.8	6.7
Asthma exacerbation	18	14.9	5.0
Pulmonary tuberculosis	12	9.9	3.4
Pleural effusion	5	4.1	1.4
Pneumothorax	2	1.7	0.6
Other pulmonary causes	2	1.7	0.6
Total	121	100.0	33.89

Infectious pneumonia was the most common bronchopulmonary cause, representing 47.9% of respiratory etiologies and 16.2% of all cases of acute dyspnea. COPD exacerbation was the second most common respiratory cause at 19.8%, followed by asthma exacerbation at 14.9%. Pulmonary tuberculosis, an important infectious disease in Madagascar, accounted for 9.9% of bronchopulmonary causes. Pleural effusion and pneumothorax were less common.

Other Etiologies

Other etiologies accounted for only 2.0% (n=7) of all cases. These included anemia (n=3), renal failure with fluid overload (n=2), metabolic acidosis (n=1), and neuromuscular disorder (n=1). The small proportion of other etiologies reflects the specialized nature of the Cardio-Respiratory Diseases Department, where most admissions are for primary cardiac or pulmonary conditions.

Discussion

Predominance of Cardiovascular Causes

Our study revealed that cardiovascular causes accounted for 64.15% of all cases of acute dyspnea in the Cardio-Respiratory Diseases Department of Morafeno University Hospital Center, making them the predominant etiology. This finding is consistent with several studies from both developed and developing countries that have identified cardiovascular diseases as a major cause of acute dyspnea in hospital settings.

The high proportion of cardiovascular causes in our study reflects the growing burden of cardiovascular diseases in sub-Saharan Africa, including Madagascar. This epidemiological transition is driven by multiple factors including urbanization, changes in dietary patterns, increased prevalence of risk factors such as hypertension and diabetes, and improved survival from infectious diseases leading to an aging population. The World Health Organization has recognized cardiovascular diseases as an emerging public health priority in low- and middle-income countries, where they now account for a substantial proportion of morbidity and mortality.

The predominance of cardiovascular causes in our setting has important implications for healthcare planning and resource allocation. It underscores the need for strengthening cardiovascular diagnostic and therapeutic capacity, including access to echocardiography, cardiac biomarkers, and evidence-based heart failure management. It also highlights the importance of preventive strategies targeting modifiable cardiovascular risk factors such as hypertension, diabetes, smoking, and obesity.

Decompensated Heart Failure as the Leading Etiology

The most striking finding of our study was the overwhelming predominance of decompensated heart failure, which accounted for 92.1% of cardiovascular causes and 59.1% of all cases of acute dyspnea. This represents a remarkably high proportion compared to many studies from high-income countries, where the etiological spectrum of acute dyspnea tends to be more diverse.

Several factors may explain the high prevalence of decompensated heart failure in our population. First, Madagascar has a high prevalence of rheumatic heart disease, a consequence of inadequate treatment of streptococcal pharyngitis in childhood. Rheumatic heart disease remains a major cause of heart failure in young and middle-aged adults in many low- and middle-income countries, despite being largely eliminated in developed nations. Second, hypertensive heart disease is highly prevalent in Madagascar, driven by high rates of undiagnosed, untreated, or inadequately controlled hypertension. Third, limited access to specialized cardiac care and medications may result in suboptimal management of chronic heart failure, leading to frequent decompensations requiring hospitalization.

The high burden of decompensated heart failure in our study population highlights several critical healthcare gaps. Access to essential heart failure medications, including angiotensin-converting enzyme inhibitors, beta-blockers, and diuretics, may be limited by availability and affordability. Echocardiography, essential for accurate diagnosis and classification of heart failure, may not be readily available in primary care settings, leading to delayed diagnosis and treatment. Patient education about heart failure self-management, including dietary sodium restriction, fluid monitoring, and medication adherence, may be inadequate. Finally, there may be limited capacity for treating underlying causes of heart failure, such as valve replacement for rheumatic heart disease.

Addressing the burden of heart failure in Madagascar will require a multifaceted approach. Primary prevention of rheumatic heart disease through improved diagnosis and treatment of streptococcal pharyngitis is essential. Secondary prevention through early detection and treatment of hypertension and other cardiovascular risk factors is critical. Improving access to essential heart failure medications and diagnostic tools, particularly echocardiography, is necessary. Strengthening heart failure management capacity through training of healthcare providers and implementation of evidence-based protocols is important. Finally, developing patient education programs to improve self-management and reduce preventable hospitalizations is needed.

Bronchopulmonary Causes

Bronchopulmonary causes accounted for 33.89% of all cases of acute dyspnea in our study, representing the second major etiological category. Within this category, infectious pneumonia was the leading diagnosis, accounting for 47.9% of respiratory causes and 16.2% of all cases of acute dyspnea.

The high prevalence of infectious pneumonia in our study reflects the substantial burden of respiratory infections in Madagascar. Several factors contribute to this burden, including high rates of poverty, malnutrition, indoor air pollution from biomass fuel use, overcrowding, limited access to healthcare, and high prevalence of HIV infection and other immunocompromising conditions. Pneumonia remains a leading cause of morbidity and mortality in Madagascar, particularly among children and elderly adults.

COPD exacerbation was the second most common bronchopulmonary cause in our study, accounting for 19.8% of respiratory etiologies. This finding reflects the growing burden of COPD in low- and middle-income countries, driven primarily by tobacco smoking and exposure to indoor air pollution from biomass fuel combustion. In Madagascar, where a significant proportion of the population relies on wood, charcoal, or other biomass fuels for cooking and heating, exposure to indoor air pollution is a major risk factor for COPD, particularly among women.

Asthma exacerbation accounted for 14.9% of bronchopulmonary causes in our study. Asthma is a common chronic respiratory disease worldwide, and acute exacerbations are a frequent cause of emergency department visits and hospitalizations. Factors that may contribute to asthma exacerbations in Madagascar include exposure to respiratory infections, allergens, air pollution, and inadequate access to controller medications such as inhaled corticosteroids.

Pulmonary tuberculosis accounted for 9.9% of bronchopulmonary causes in our study. Madagascar has a high burden of tuberculosis, with an estimated incidence of over 200 cases per 100,000 population. Tuberculosis can present with dyspnea due to extensive parenchymal disease, pleural effusion, or associated complications such as pneumothorax or secondary bacterial pneumonia. The presence of tuberculosis as a significant cause of acute dyspnea underscores the importance of maintaining a high index of suspicion for this disease and ensuring access to diagnostic testing and treatment.

The substantial burden of bronchopulmonary causes of acute dyspnea in our study highlights the need for strengthening respiratory disease management capacity. This includes improving access to chest radiography and other diagnostic tools, ensuring availability of essential medications for pneumonia, COPD, and asthma, strengthening tuberculosis diagnostic and treatment programs, and implementing interventions to reduce exposure to risk factors such as tobacco smoke and indoor air pollution.

Study Limitations

Several limitations of our study should be acknowledged. First, as a retrospective study based on medical records, the quality and completeness of data were dependent on the documentation practices of healthcare providers. Some relevant clinical information may have been missing or incompletely recorded. Second, the study was conducted at a single tertiary referral center, which may limit the generalizability of findings to other healthcare settings in Madagascar, particularly primary care facilities or rural hospitals. The case mix at a specialized cardio-respiratory department may differ from that in general medical wards or emergency departments.

Third, the diagnostic workup available to patients was limited by resource constraints typical of low-income settings. Not all patients had access to advanced diagnostic tests such as computed tomography, ventilation-perfusion scanning, or cardiac catheterization. This may have resulted in some misclassification of etiologies or inability to identify certain diagnoses. Fourth, the study did not capture information on disease severity, treatment outcomes, or long-term follow-up, which would have provided additional insights into the clinical significance of different etiologies.

Fifth, the study period included 63 months, during which there may have been changes in disease patterns, diagnostic capabilities,

or treatment practices that were not accounted for in the analysis. Finally, the study did not include a control group or comparison with other populations, which limits the ability to draw conclusions about risk factors or causal relationships.

Despite these limitations, our study provides valuable data on the etiological profile of acute dyspnea in a resource-limited setting in Madagascar, filling an important knowledge gap and providing a foundation for future research and quality improvement initiatives.

Clinical Implications

The findings of our study have several important clinical implications. First, the overwhelming predominance of decompensated heart failure as a cause of acute dyspnea suggests that clinical algorithms and diagnostic protocols in this setting should prioritize rapid assessment for heart failure. This includes focused history taking for symptoms and risk factors of heart failure, physical examination for signs of volume overload and cardiac dysfunction, and appropriate use of diagnostic tests such as chest radiography, electrocardiography, and echocardiography when available.

Second, the high burden of infectious pneumonia highlights the importance of early recognition and appropriate antibiotic treatment of respiratory infections. Clinical protocols should emphasize the use of validated severity assessment tools to guide decisions about hospitalization and antibiotic selection. Efforts to improve access to chest radiography and microbiological testing, where feasible, can enhance diagnostic accuracy and antimicrobial stewardship.

Third, the substantial contribution of COPD and asthma exacerbations to the burden of acute dyspnea underscores the importance of chronic disease management and prevention of acute exacerbations. This includes ensuring access to controller medications, providing patient education about trigger avoidance and early recognition of exacerbations, and implementing smoking cessation programs.

Fourth, the presence of tuberculosis as a significant cause of acute dyspnea emphasizes the need for maintaining a high index of suspicion for this disease, particularly in patients with risk factors such as HIV infection, malnutrition, or exposure to known tuberculosis cases. Systematic screening for tuberculosis in patients presenting with acute dyspnea may be warranted in high-burden settings.

Finally, the findings highlight the need for a comprehensive approach to managing acute dyspnea that addresses both immediate stabilization and long-term management of underlying conditions. This includes not only acute treatment of the presenting episode but also optimization of chronic disease management, patient education, and linkage to appropriate follow-up care.

Conclusion

Acute dyspnea represents a significant burden of disease in Madagascar, with decompensated heart failure and infectious pneumonia as the leading causes. Addressing this burden will require a comprehensive approach that includes primary prevention of cardiovascular and respiratory diseases, strengthening of diagnostic and therapeutic capacity, improved access to essential medications and technologies, and enhanced patient education and chronic disease management programs. The findings of this study provide a foundation for evidence-based approaches to managing acute dyspnea in Madagascar and similar resource-limited settings [1-30].

References

1. Parshall MB, Schwartzstein RM, Adams L, Harold LM, Peter MC, et al. (2012) An official American Thoracic Society statement: update on the mechanisms, assessment, and management of dyspnea. *Am J Respir Crit Care Med* 185: 435-452.
2. Berliner D, Schneider N, Welte T, Bauersachs J (2016) The differential diagnosis of dyspnea. *Dtsch Arztebl Int* 113: 834-845.
3. Mullerova H, Lu C, Li H, Tabberer M (2014) Prevalence and burden of breathlessness in patients with chronic obstructive pulmonary disease managed in primary care. *PLoS One* 9: 85540.
4. Ray P, Birolleau S, Lefort Y, Becquemin MH, Beigelman C, et al. (2006) Acute respiratory failure in the elderly: etiology, emergency diagnosis and prognosis. *Crit Care* 10: R82.
5. Remes J, Miettinen H, Reunanen A, Pyörälä K (1991) Validity of clinical diagnosis of heart failure in primary health care. *Eur Heart J* 12: 315-321.
6. Ponikowski P, Voors AA, Anker SD, José Ramón GJ, Luis MR, et al. (2016) ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *Eur Heart J* 37: 2129-2200.
7. Yancy CW, Jessup M, Bozkurt B, Javed B, Donald E C, et al. (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. *Circulation* 128: 1810-1852.
8. Watkins DA, Johnson CO, Colquhoun SM, Andrea B, Andrew CS, et al. (2017) Global, regional, and national burden of rheumatic heart disease, 1990-2015. *N Engl J Med* 377: 713-722.
9. Mayosi BM, Robertson KA, Volmink JA, Albert A, Shan BS, et al. (2006) The Drakensberg declaration on the control of rheumatic fever and rheumatic heart disease in Africa. *S Afr Med J* 96: 246.
10. Damasceno A, Mayosi BM, Sani M, Charles M, Charles KK, et al. (2012) The causes, treatment, and outcome of acute heart failure in 1006 Africans from 9 countries. *Arch Intern Med* 172: 1386-1394.
11. Kengne AP, Dzudie A, Sobngwi E (2008) Heart failure in sub-Saharan Africa: A literature review with emphasis on individuals with diabetes. *Vasc Health Risk Manag* 4: 123-130.
12. Bloomfield GS, Barasa FA, Doll JA, Velazquez EJ (2013) Heart failure in sub-Saharan Africa. *Curr Cardiol Rev* 9: 157-173.
13. Sliwa K, Davison BA, Mayosi BM, Sani M, Charles M, et al. (2013) Readmission and death after an acute heart failure event: predictors and outcomes in sub-Saharan Africa: results from the THESUS-HF registry. *Eur Heart J* 34 : 3151-3159.
14. Keates AK, Mocumbi AO, Ntsekhe M, Sliwa K, Stewart S (2017) Cardiovascular disease in Africa: epidemiological profile and challenges. *Nat Rev Cardiol* 14: 273-293.
15. Mensah GA, Roth GA, Sampson UK, Andrew EM, Forouzanfar MH, et al. (2015) Mortality from cardiovascular diseases in sub-Saharan Africa, 1990-2013: a systematic analysis of data from the Global Burden of Disease Study 2013. *Cardiovasc J Afr* 26: S6-S10.
16. Adeloye D, Basquill C, Aderemi AV, Thompson JY, Obi FA (2015) An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. *J Hypertens* 33: 230-242.
17. Twagirumukiza M, De Bacquer D, Kips JG, de Backer G, Stichele RV, et al. (2011) Current and projected prevalence of arterial hypertension in sub-Saharan Africa by sex, age and habitat: an estimate from population studies. *J Hypertens* 29: 1243-1252.
18. Opie LH, Seedat YK (2005) Hypertension in sub-Saharan African populations. *Circulation* 112: 3562-3568.
19. Mbewu A, Mbanya JC, Jamison DT, Feachem RG, Makgoba MW, et al. (2006) Cardiovascular disease. In: editors. *Disease and Mortality in Sub-Saharan Africa*. 2nd edition. Washington (DC): World Bank Chapter 21.
20. (2014) Global status report on noncommunicable diseases 2014. Geneva: World Health Organization.
21. Rudd KE, Johnson SC, Agesa KM, Danny VC, Kevin SI, et al. (2020) Global, regional, and national sepsis incidence and mortality, 1990-2017: analysis for the Global Burden of Disease Study. *Lancet* 395: 200-211.
22. Wahl B, O'Brien KL, Greenbaum A, Harish N, David AM, et al. (2018) Burden of *Streptococcus pneumoniae* and *Haemophilus influenzae* type b disease in children in the era of conjugate vaccines: global, regional, and national estimates for 2000-15. *Lancet Glob Health* 6: e744-e757.
23. Troeger C, Blacker B, Khalil IA, Puja CR, Jackie C, et al. (2018) Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory infections in 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Infect Dis* 18: 1191-1210.
24. Adeloye D, Song P, Zhu Y, Harry C, Aziz S, et al. (2022) Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. *Lancet Respir Med* 10: 447-458.
25. Mortimer K, Ndamala CB, Naunje AW, William W, Daniel P, et al. (2017) A cleaner burning biomass-fuelled cookstove intervention to prevent pneumonia in children under 5 years old in rural Malawi (the Cooking and Pneumonia Study): a cluster randomised controlled trial. *Lancet* 389: 167-175.
26. Gordon SB, Bruce NG, Grigg J, Kevin M, Kalpana B, et al. (2014) Respiratory risks from household air pollution in low and middle income countries. *Lancet Respir Med* 2: 823-860.
27. (2020) Global tuberculosis report 2020. Geneva: World Health Organization.
28. Glaziou P, Floyd K, Raviglione MC (2018) Global epidemiology of tuberculosis. *Semin Respir Crit Care Med* 39: 271-285.
29. Chakaya J, Khan M, Ntoumi F, Fatima R, Peter M, et al. (2021) Global Tuberculosis Report 2020 - Reflections on the Global TB burden, treatment and prevention efforts. *Int J Infect Dis* 113: S7-S12.
30. Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57-72.

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