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Cardiovascular disease prevention and management in the COVID-19 era and beyond: An international perspective



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ABSTRACT

Despite some indicators of a localized curtailing of cardiovascular disease (CVD) prevalence, CVD remains one of the largest contributors to global morbidity and mortality. While the magnitude and impact of the coronavirus disease 2019 (COVID-19) pandemic have yet to be realized in its entirety, an unquestionable impact on global health and well-being is already clear. At a time when the global state of CVD is perilous, we provide a continental overview of prevalence data and initiatives that have positively influenced CVD outcomes. What is clear is that despite attempts to address the global burden of CVD, there remains a lack of collective thinking and approaches. Moving forward, a coordinated global infrastructure that, if developed with appropriate and relevant key stakeholders, could provide significant and longstanding benefits to public health and yield prominent and consistent policy resulting in impactful change. To achieve global impact, research priorities that address multi-disciplinary social, environmental, and clinical perspectives must be underpinned by unified approaches that maximize public health.

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Abbreviations: BMI, Body Mass Index; CR, Cardiac Rehabilitation; CV, cardiovascular; CVD, cardiovascular disease; COVID-19, Coronavirus disease 2019; DALYs, Daily Adjusted Life Years; DM, Diabetes mellitus; eNOS, Endothelial Nitric Oxide; ESC, European Society of Cardiology; HF, heart failure; LIC, Low-Income Countries; MET, Metabolic equivalent; VO2 peak, Peak oxygen uptake; PA, Physical Activity; SARS-COV-2, Severe Acute Respiratory Syndrome Coronavirus 2; SSA, Sub-Saharan Africa; UAE, United Arab Emirates; WHO, World Health Organization.

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Introduction

The coronavirus 2019 (COVID-19) pandemic has had an unquestionable impact on global health and well-being. Necessarily implemented and enforced pandemic restrictions (e.g., social distancing and school closures) created additional barriers related to the adoption of healthy lifestyle behaviors, such as physical activity (PA) and optimal dietary consumption. The restrictions imposed during the global lockdowns likely contributed to the worsening trends in population-level cardiometabolic risk factor control (e.g., diabetes, obesity, dyslipidemia, poor blood pressure control).^{1–5} Likewise, the global burden of cardiovascular (CV) disease (CVD) in respect to disability-adjusted life years (DALYs) and deaths was on a sharp increase, largely due to changes in modifiable risk factors before the pandemic (Fig. 1)⁶ and has no doubt been magnified due to extensive social distancing and lockdowns enacted to prevent widespread transmission. Indeed, global reports that highlight an increase in excess deaths due to CVD and diabetes are a telltale sign of the limited access to preventative CV services, and reduced surveillance of cardiovascular risk factors and behaviors during the pandemic.^{7–9}

Whilst post-pandemic global recovery efforts are ongoing, their current focus is primarily positioned to restore social and economic activities rather than addressing health and wellbeing impacts and increased health inequalities, the latter of which have been and continue to broaden as an indirect consequence of the COVID-19 pandemic.^{10,11} While restorative social and economic efforts are needed, equal attention should be paid to restoring population health and well-being, where lasting impacts have yet to be realized and are likely catastrophic if overlooked.¹² In this context, enforced social distancing, restrictions on activities, and national lockdowns which occurred at a time when healthcare provision was realigned to address the immediate threat to global health will undoubtedly have a lasting impact on chronic disease areas, such as CVD; the interplay between the COVID-19 pandemic and CVD incidence and prevalence moving forward will not be fully understood for some time. There is also a growing issue of post-COVID syndrome or Long COVID, which is estimated to affect >144 million people globally.¹³ Importantly, this figure is likely to be augmented with continued removal/relaxing of social distancing measures, reduced

access to testing and continued transmission of the virus in its current form as well as future variants,¹² especially in those with a history of CVD and/or longstanding morbidity.^{14,15} Before COVID-19, CVD, including coronary heart disease, stroke, and heart failure (HF), affected nearly 9.3% of adults aged 20 years globally.¹⁶ In this review, we present a continental overview of the current state of CVD to highlight: 1) the magnitude of the issue; and 2) areas of effective practice that can and should be considered for adoption globally when feasible.

North America

Irrespective of COVID-19's influence on CV health, the percentage of CVD cases in the United States (US), most notably stroke and HF, is forecasted to rise dramatically from 2025 to 2060, in tandem with the growing prevalence of CVD risk factors (e.g., diabetes, obesity, hypertension, dyslipidemia).¹⁷ Arguably of greater concern is the projected rates that are expected to disproportionately affect racial and ethnic minority populations who historically have had reduced access to healthcare and experience mounting barriers to prevention and treatment resources due to complex social determinants of health,¹⁷ thus providing a further demonstration of social injustice.¹¹ These trends, while worrisome, present enormous opportunities to alleviate the burden of CVD with patient-centered strategies that promote engagement in healthy living behaviors, the cornerstone of CVD prevention.¹⁸ Behavioral medicine interventions integrate multidisciplinary factors including personal, environmental, and psychosocial barriers, and thus, play a key role in addressing CVD risk factors.¹⁹ Inherent to behavioral medicine are the theoretical principles of health behavior change that provide a blueprint on how to assist individuals in adopting and maintaining optimal health behaviors. For example, lifestyle interventions based on Social Cognitive Theory emphasize self-efficacy and social support to promote initiation and maintenance of behaviors,²⁰ whereas interventions based on the Transtheoretical Model of Behavior Change may apply strategies focused on decisional balance (the pros and cons that influence the decision) to guide motivation for and maintenance of exercise engagement.^{21,22} A third behavioral construct based on Self-Determination Theory is grounded in three intrinsic psychological needs that drive motivation and lasting behavior change: 1) autonomy

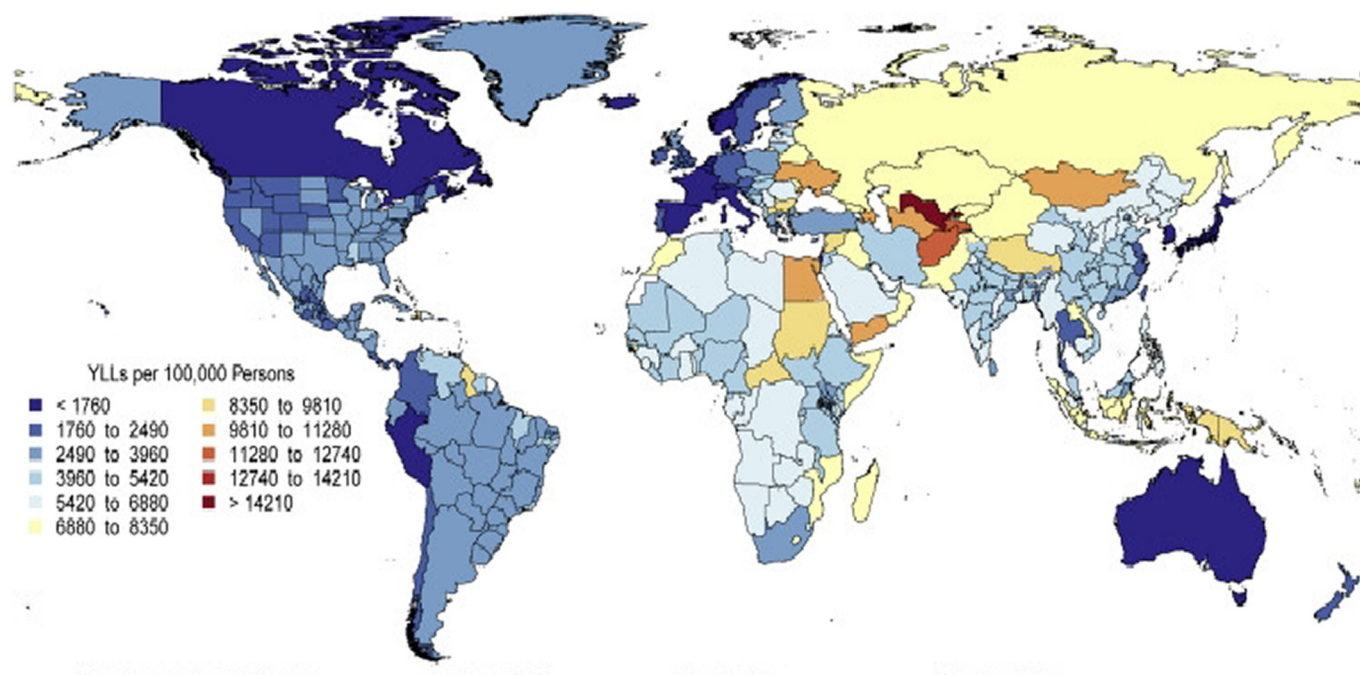


Fig. 1. A global map, demonstrating age-standardized years of life lost due to CVD in 2019. Figure adapted from Roth et al.⁶

(i.e., choice of activity, behavior or preference and control); 2) competence (i.e., knowledge, mastery of skills, self-efficacy); and 3) relatedness (i.e., connection and belongingness to others).^{23,24} Importantly, the Self-Determination Theory provides the theoretical underpinnings of the 5A Model (i.e., assess, advise, agree, assist, and arrange) for delivering lifestyle-related behavior change counselling in the clinical care settings.²³

An overwhelming body of literature supports the role of behavioral lifestyle interventions addressing suboptimal dietary intake and insufficiencies in PA to promote cardiometabolic health in populations with varying levels of CVD risk.^{18,25,26} Studies focused on dietary modification traditionally target single nutrients (e.g., increased fiber, reduction in sugar, fat or sodium <2300 mg/day to improve cardiometabolic health^{27–30}) although more robust evidence exists for adherence to a Mediterranean style diet, Dietary Approaches to Stop Hypertension (DASH) style, or plant-based dietary patterns.^{31–34} Accordingly, studies that employed behavioral exercise interventions conventionally focus on optimizing exercise dose by varying one or more discrete factors (i.e., frequency, intensity, duration, and type of exercise). Exercise, when performed at the appropriate “dose,” has been shown to positively influence CVD risk factors, including plasma lipids, hypertension, diabetes mellitus, and obesity.³⁵ While there is stronger support for the cardiovascular impact of aerobic/endurance exercise,^{18,35} several studies compellingly suggest that clinical and physiological benefits of resistance training for CVD risk reduction, including a 17% reduction in CVD mortality,³⁶ can be achieved in those with and without CVD.^{37,38}

To make an even larger impact on population-level changes in CVD burden, several scientific organizations within the US^{23,31,39} are prioritizing action on the delivery or referral of equitable behavioral lifestyle interventions in clinical practice, which provide the ideal environment for shared decision-making between patients and health provider (s) and allow for ongoing support through frequent follow-ups, which maximizes the likelihood of behavioral change maintenance.²³ In this regard, interventions based exclusively on behavioral counselling have been shown to adequately promote and maintain healthy behaviors and reduce cardiovascular risk factors for primary⁴⁰ and secondary CVD prevention.³¹ Structured interventions delivered in clinical settings have demonstrated similar success in producing long-term maintenance of behavior modification (i.e., 6 months to ≥1 year) in patients with elevated CVD risk. For example, interventions focused on nutrient or diet modification have been shown to effectively improve one or more CVD risk factors long-term, including blood pressure, lipids, adiposity, and glucose control. Likewise, PA-only interventions aimed at increasing step count or time spent in total or moderate-intensity PA, and multicomponent interventions targeting diet and PA have resulted in long-term reductions in body weight and better blood pressure control in various high-risk adults, including racially and ethnically minorized populations.³⁹ Outpatient cardiac rehabilitation (CR), though not conventionally thought of as an ‘intervention’ per-se, is considered one of the most effective behavioral programs for secondary CVD prevention in those with a CVD diagnosis, including heart failure.⁴¹ Traditional CR programs provide personalized exercise prescriptions based on initial assessments and individualized goals, in addition to comprehensive behavioral counselling in the form of motivational interviewing, goal setting and self-monitoring to promote self-efficacy and encourage autonomous motivation, which are critical facets of influencing participation and long-term adherence to exercise or PA and improving clinical outcomes.⁴² Unfortunately, evidence-based behavioral programs, such as those applied in CR have had historically low referral and attendance rates in clinical settings. However, with increasing recognition of the health, equity, and economic consequences of suboptimal diet and PA, there has been a growing impetus for healthcare, government and community-level systems to invest in approaches that lend to improved health screening and increase provisions of evidence-based behavioral intervention delivery in a way that promotes accountability and quality of preventative care to all populations.⁴³ Only time will tell whether

such resolutions are effective at taming the rising tide of CVD in North America.

South America

The number of CVD-related deaths in South America is predicted to be approximately 60% of all-cause mortality between 2000 and 2020.⁴⁴ Furthermore, in a case review of 1237 individuals that were characterized as being at high risk of developing CVD, 49% of participants demonstrated associated levels of high visceral fat and abdominal obesity, 41% of dyslipidemia, 38% of smoking and 33% of hypertension.⁴⁵ Accordingly, the combination of obesity and hypertension in the same individual appears to be a particular characteristic of Latin American populations, which dramatically increases cardiovascular risk factors.⁴⁶ The clustering of these significant cardiovascular risk factors may be associated with socioeconomic changes that promote the adoption of more sedentary lifestyles and less healthy eating habits.⁴⁷ It is estimated that by 2025, the global prevalence of obesity, defined by a body mass index (BMI) ≥30 kg/m², will reach 18% in men and 21% in women.⁴⁸ Abdominal obesity has been identified as the most important risk factor of CVD in Latin America, significantly contributing to risk of a first acute myocardial infarction.⁴⁵ Furthermore, if cardiovascular risk factors are not controlled in middle-aged adults, they can facilitate a series of pathophysiological processes in old age.

It is important to acknowledge there is currently a paucity of available data to inform detailed cross-continental comparisons, however, the available data does reflect a need for national and international efforts to prevent, treat and control CVD within South America; the associated risk factors for CVD should be considered a public health priority. The biggest “obstacle” in preventing CVD in adults and children remains lifestyle modifications, changes in diet and implementation of regular PA and exercise being of primary importance. The challenges in promoting healthy living habits in Latin America are numerous, at the forefront of these challenges, unfortunately, is this region of the world is characterized by greater social inequality.^{11,49} Poor nutritional habits are linked to sedentary behaviors, suggesting that this can lead to a positive energy balance and, consequently, to overweight and obesity.⁵⁰ It has recently been shown that adults who follow a healthy diet live longer and have a lower risk for obesity, type 2 diabetes, CVD, and certain types of cancer.^{1,2,51} Based on these findings, developing public health policies focusing on measures to encourage a healthy lifestyle (e.g., diet and exercise) is of great importance.⁵² A seminal meta-analysis by Kodama et al. observed that a 1 metabolic equivalent (MET) increase in cardiorespiratory fitness was associated with a 15% reduction in all-cause CVD mortality.⁵³ In this context, regular moderate-intensity exercise, to optimize peak MET level, is highly recommended, especially in the prevention of chronic diseases.⁵⁴ National programs focusing on lifestyle modification interventions should be initiated and strengthened in Latin America to combat the CVD epidemic.^{2,55} Currently, 150 min/week of moderate aerobic activity or 75 min/week of vigorous aerobic activity is recommended.⁵⁶ The combination of aerobic and resistance exercise has been shown to reduce the risk of developing CVD and stroke.⁵⁷ Regular PA induces holistic physiological adaptations that benefit human cardiovascular and general health and well-being. An important observation is that, unlike most drugs, exercise is, in the vast majority of individuals, free of adverse effects and clearly improves health trajectory; the time to universally accept PA as a primary medicine for the prevention and management of CVD is long overdue.

Europe

Current estimates highlight that one hundred and thirteen million people are living with CVD in Europe, which remains the leading cause of death on the Continent.⁵⁸ In Central and Eastern Europe CVD accounts for >4 million deaths per year.⁵⁹ Despite the widespread and

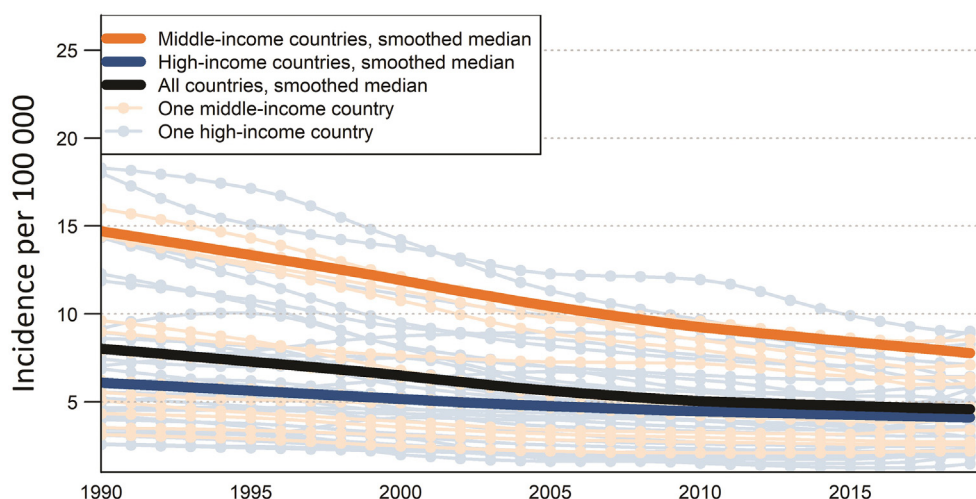


Fig. 2. Time series: age-standardized incidence of rheumatic heart disease in European Society of Cardiology member countries (1990–2019) Data presented by the European Society of Cardiology.¹⁴⁸

well-documented impacts on population health and wellbeing, CVD maintains a major economic impact across Europe, with most recent estimates reporting >€210 billion a year being spent to address this health crisis.⁶⁰ These costs comprise the direct costs that are imposed on healthcare systems (i.e., treatment costs) and non-health costs such as productivity losses and informal care of people with CVD. Whilst trends in data across Europe have demonstrated reductions over recent decades,⁶¹ changes in prevalence are not universal and highly variable as a result of diverse sociopolitical and economic differences,⁵⁹ as demonstrated in Fig. 2. In Europe, Central and Eastern European countries (e.g., Poland, Bulgaria, and the Czech Republic) maintain the highest rates of CVD mortality in Europe; when standardized for age, death rates in Latvia and Romania are twice as high as the continental average (883 and 951 vs. 373.6 per 100,000 inhabitants, respectively).⁶² These statistics cover an expansive landmass that comprises fifty-three states, such as France and Spain. Moreover, countries outside of the European Union (EU), such as Israel, have strikingly lower age-standardized death rates demonstrating a disparity in CVD statistics among Central and Eastern European countries and some Independent Commonwealth states. Upon further examination of the data, not only is there a disparity in the prevalence of CVD risk factors and all-cause mortality but there are also apparent differences in the age profile associated with CVD. Premature mortality from CVD is defined as anyone younger than <65 years of age. In countries such as Russia and Belarus, males are ten times more likely to suffer from premature mortality compared with aged match males in Switzerland (300 vs. 26 per 100,000, respectively).⁶³

Data presented by Timmis et al.,⁵⁸ on behalf of the European Society of Cardiology (ESC) provides an eloquent summary of the CVD landscape in Europe, a review that includes a substantial overview of pertinent risk factors which include but are not limited to: 1) environmental risk factors (e.g., air and noise pollution and contribute to over 75% of the CVD burden); 2) health behaviors (e.g., smoking, physical inactivity and dietary factors); and 3) clinical risk factors (e.g., high blood pressure, cholesterol and obesity which have all observed sustained increases in recent decades).⁵⁸ Arguably an important facet of the CVD narrative that is important but not necessarily unique to Europe is the clear divide between low- and high-income areas, where social injustice and health inequalities are evident, the vicious cycle between poverty and accessing healthcare services is a factor in these disparities.⁶⁴ This can be extended to add a further dimension of complexity, which is at best disparate in Europe and highlights a need to address causal mechanisms between those frequently adopting unhealthy living behaviors,

in a chicken and egg scenario.¹ Well documented is the need to engage and practice healthy living behaviors, which remains a key global challenge that has been the basis of several key continental and global initiatives to improve adoption and adherence to healthy living behaviors but until now these have been ineffective and impacted by a lack of widespread scalability and accessibility. In reality, unhealthy living behaviors will continue to pose a formidable threat to population health for years to come without a meaningful and coordinated global infrastructure that tackles social injustice and health inequalities via united approaches and shared practice.⁶⁵

Africa

CVD related deaths in Sub-Saharan Africa (SSA) have increased by >50% in the past three decades.⁶⁶ In SSA, CVDs are responsible for approximately 37% of all chronic disease-related deaths⁶⁷ with the most common all-cause-related CVD death being ischemic heart disease, stroke, and hypertensive heart disease.^{66,68} Notably, the World Health Organization (WHO) estimates the prevalence of hypertension as the highest in the African region, with about 46% of adults aged 25 years and older being hypertensive compared to the rest of the world.⁶⁹ Unfortunately, levels of hypertension access to screening, appropriate diagnosis and treatment in this region are low, with an estimated 40% of diabetes patients unaware of their diagnosis.⁶⁷ A review by Yuyun et al., on CVDs in SSA from 1990 to 2019 estimates the prevalence rates of CVD risk factors as follows: 1) Smoking at 10%; 2) hypertension at 30% (40% in urban and 20% in rural areas); 3) diabetes at 7%; 4) dyslipidemia at 25%; 5) physical inactivity at 22%; and 6) obesity being higher among women (2–40%) compared to men (1–15%). The true burden of these risk factors and their complications in SSA remain uncertain as most of these countries are either void of data or have deficient data recording systems hence not sufficiently dependable to support mounting of a commensurate response⁷⁰ and/or policy development. Another major concern in SSA is the tendency of CVDs to occur at younger ages, approximately two decades earlier compared to high-income countries.⁷¹ This poses an additional risk to family and community well-being (economic impact for loss of productive years of life),⁷² regional socioeconomic development and health systems sustainability.⁶⁷ Therefore, interventions targeting the younger population, especially in healthy living and behavioral changes, are crucial in primary prevention and should be a key strategy to reduce morbidity and mortality from CVDs in SSA.

Although there are advocacies to increase interventions targeting the prevention and control of CVDs in Africa, there are several concerns that handicap this notion. There is evidence of insufficient healthcare infrastructure and resources, scarcity of cardiac professionals, skewed budget allocation and disproportionate prioritization away from chronic disease, such as CVD.⁶⁷ Ultimately, setting up healthcare infrastructure and systems for the management of CVDs is expensive given costly CVD diagnostics and interventions, as well as the need for lifelong use of expensive CVD medications. There are also notable barriers to complete compliance with prescribed medications.⁷³ Most of the population in Africa may not be able to afford such health care costs which are then projected as an economic burden to the community through fundraising initiatives to support the ailing members.

In addition, difficulties in the planning and implementation of effective interventions targeting healthy living and behavioral change for CVD prevention and management in most African countries are compounded by a paucity of studies and a low rate of investment in research and data acquisition.⁷⁴ Although some work may exist in smaller clusters targeting some population groups across Africa, it is difficult to analyze or summarize CVD prevention and management interventions and approaches since most of these initiatives are not documented. Recent systematic reviews⁷⁵ have also noted that the interventions for CVD prevention and management in low-income countries (as defined by the Organization for Economic Co-operation and Development) are mostly limited to Asian countries and the lack of studies from SSA countries is concerning. Overall, there are insufficient preventive strategies at a population level cutting across both urban and rural Africa,⁷⁴ warranting further for systematic approaches to address such gaps.

A recent review of SSA⁷⁶ concludes that effective population-based screening initiatives and prevention measures for CVDs are hindered by low levels of knowledge and awareness of CVD and its risk factors, coupled with inaccurate perceptions of the severity of risk.⁷⁷ Studies conclude that there are huge knowledge and capacity gaps in CVD services delivery in many African countries.^{77–81} and thus interventions targeting knowledge and uptake of healthy living through health education and awareness creation, training of the public and health workers, lifestyle consultation and counselling and community mobilization seem more likely to lead to significant changes.⁷⁵ Such strategies, especially in SSA aimed at changing people's knowledge, attitudes and/or behaviors are considered a crucial first step in the prevention and management of CVDs, coupled with community mobilization and social activities to create an enabling environment.⁸² Considering this, the high number of behavioral interventions is not surprising. Such interventions mostly involve education and communication materials using mass media and mobile phone applications, individual or group counselling, and training for providers and health workers including local community health workers, champions, and peers.

It is notable that besides primary medical care, most interventions are community-based and target specific settings, population groups and organizations across both urban and rural areas. They are designed to prevent the development of CVD risk factors or control them, including healthy living and behavioral changes and usually include strategies to create policy and influence environmental changes.^{83,84} Community-based interventions are seen to trigger a reduction in CVD burden and risk across entire communities impacting population-level knowledge and perceptions and risk reduction practices.^{85,86} These approaches are also likely to be more cost-effective⁸⁷ and reach the grassroots of the vast African population than treatment-oriented programs which most low-income countries (LICs) in SSA cannot implement on a large scale.⁸⁸ However, due to poor documentation in SSA and the paucity of published findings on the outcomes of the implemented interventions, there is a limited evidence-based conclusion regarding their effectiveness in community settings.

Amegah *et al* used a community-driven participatory approach in four African countries— Rwanda, Malawi, Ethiopia, and South Africa targeting participants aged 18–65 years from lower socio-economic

status communities, to explore CVD risk perceptions and to develop community-specific advocacy and prevention strategies in the rural and urban SSA settings.⁸⁹ The project's approach was to engage with and train community members to facilitate conceptualization, co-designing of the research, data gathering, and co-creation of knowledge and disease prevention advocacy through community engagement and using mobile technology. A successful program on the prevention of CVD in Seychelles^{90,91} was community-based, with healthcare brought to the population at their doorsteps. Key strategies that contributed to the success of this project included a focus on public education that was delivered by non-physician health providers, including nurses and community health workers, with physicians playing more of a supervisory role.

Notably, the CVD epidemic in SSA is driven by changing lifestyles including physical inactivity, increased alcohol intake and tobacco use, and increased consumption of foods high in saturated fat, salt, and sugar.⁸⁹ This is linked to rapidly increasing urbanization, modernization, westernization, socioeconomic development, and the embrace of free market policies.⁸⁹ For instance, the nutrition transition in SSA countries, characterized by a shift from the traditional African diet to highly processed and fast foods is linked to the rapid increase in CVDs. A similar transition in physical activity is being observed whereby a shift from labor-intensive and actively involving daily chores that were culturally embedded in the day-to-day activities of living are now being replaced with more sedentary, labor-saving, mechanized operations,⁹² has also been linked to the CVD epidemic. Notably, Food-based dietary guidelines (FBDGs), promoted globally as a vital component of national food and nutrition policies, are important for effecting dietary and lifestyle modification in populations for public health gains.⁸⁹ According to the Food and Agriculture Organization database, as of 2018, only seven out of 54 African countries (i.e., South Africa, Benin, Sierra Leone, Seychelles, Kenya, Namibia, and Nigeria) had FBDGs. The most recently published guidelines (in 2017) were for Kenya while the Namibia guidelines were the first to be published (in 2000).⁸⁹ There is a lack of empirical data on how these African dietary guidelines have been implemented and their effectiveness in promoting healthy eating and healthy living habits for curtailing CVDs.

Middle East

Increasing economic ties between the gulf countries and considerable changes in the living standards have contributed to an inactive lifestyle among the population in the middle east, which primarily includes Saudi Arabia, Qatar, Oman, Bahrain, Kuwait, and the United Arab Emirates (UAE).⁹³ High-income groups and urban areas in gulf countries are facing an increasing prevalence of NCDs, which currently contribute to approximately 60% of the total burden of disease in this region.⁹⁴ Diet, rapid urbanization, smoking, and tobacco consumption are some of the factors related to the epidemiological transition of CVDs.⁹⁴ Moreover, countries like Saudi Arabia have also gone through a major economic transition, and it is postulated that this rapid urbanization may be linked to the higher prevalence of CVD within the region.⁹⁵ The PURE-Saudi research group evaluated the prevalence of unhealthy living behaviors and CVD risk factors, in Saudi Arabia's central region,⁹⁶ reporting a high prevalence of CVD risk factors and sedentary lifestyles among the population. Similar findings were also reported in the UAE where the population had a high prevalence of CVD risk factors.⁹⁷ Research related to CVD as evaluated by the INTERHEART study found that >90% of the population in the middle east is at risk of developing CVD. This is directly related to a high prevalence of key risk factors such as smoking, type-2 diabetes mellitus obesity, hypertension, and hypercholesterolemia.⁹⁶ Studies further highlight a higher prevalence of CVD risk in the female population (>50 years) as compared to their male counterparts.⁹⁸ A plausible reason for that could be prevalent social cultures that may hinder awareness regarding healthy lifestyle approaches. As stated by the WHO, a

sedentary lifestyle has been ranked as the fourth emerging risk factor for worldwide deaths, which is expected to account for almost 6% of the worldwide mortality rate.⁹⁹ In a study conducted in Saudi Arabia alone, 59% of the population was found to be physically inactive.⁹⁹ Prevalent CVD risk factors in the Middle East have led to troubling health trajectories. CVD-related mortality is currently 23% in Qatar, 32% in Bahrain, 38% in UAE, 42% in Saudi Arabia, 46% in Kuwait and 49% in Oman, respectively. The study also highlighted that the prevalence of myocardial infarctions was more likely to occur earlier in life in individuals that are living in the Middle East when compared to western counterparts.⁹⁶

Asia

Asia is the largest continent by size (totaling over 30% of the world land area) and accounts for 60% of the world's total population, with China and India alone contributing to 35% of the world's population.¹⁰⁰ The continent houses over 48 countries, is considered the fastest-growing region in the world and is known for its diverse geopolitical and cultural practices.¹⁰¹ The majority of the Asian countries are categorized as low-income or low-middle-income economies and are undergoing significant economic and demographic transition.¹⁰² Notwithstanding the economic development and advancements in healthcare, Asian countries continue to present with significant disparities in social support systems and inequitable access to healthcare resources and facilities.¹⁰³ Currently, CVD is the leading cause of death in Asia and contributes to over half of global deaths. Ischemic heart disease (47%) and stroke (40%) account for 87% of these deaths in Asia.¹⁰⁴ Heart failure is also emerging as a major health crisis in Asian countries where individuals with heart failure are relatively younger, receive limited medical attention and are likely to be more disabled.^{105,106} Nearly 40% of CVD-related deaths in Asia are considered premature and this is accelerated by the gene-environment interaction resulting in a higher cardiometabolic risk profile and a significant increase in DALYs.^{6,107} The prevalence and impact of important CVD risk factors such as diabetes, hypertension, obesity, and physical inactivity are also reaching epidemic proportions. Over 60% of global diabetes cases reside in Asia.¹⁰⁸ Similarly, the prevalence of hypertension is significantly increasing, affecting over 20 to 50% of adults, and driving the stroke epidemic in various Asian countries.¹⁰⁹ The prevalence of overweight and obesity varies among Asian countries and between 1990 and 2013, has gradually increased by 16–38%.¹¹⁰ Compared to the Western population, Asians have lower BMI but higher total and central adiposity, making them more susceptible to CVD and its risk factors at much lower BMI thresholds.¹¹¹ This has led to recommendations for Asia-specific BMI cut-points to define increased risk (≥ 23 kg.m-2).¹¹² The prevalence of physical inactivity varies significantly across Asia and in general, is greater in high-income Asian countries and South Asia.¹¹³ In addition, indigenous Asian practices such as smoking hookah and bidi, using smokeless tobacco and chewing betel quid also contribute to an increased risk of CVD.^{114,115}

COVID-19 has not only negatively impacted health behaviors,¹¹⁶ but has also stretched an already fragile health system and needs an integrated approach to combat the ever-increasing onslaught of the CVD epidemic in Asia.¹¹⁷ COVID-19 has helped policymakers and health professionals prioritize a healthy lifestyle and has encouraged people to reconnect with traditional practices such as mindfulness, meditation and yoga.¹¹⁸ Despite a fragile, inequitable health system Asia is home to rich cultural practices and heritage which in response to the increasing burden of CVD and other chronic diseases, has been a concerted effort to promote health and well-being using culturally sensitive means and practices. National approaches towards the prevention and control of CVD in Asian countries have predominantly been holistic and have included culturally sensitive measures such as the promotion of traditional diets, yoga, meditation, and complementary and alternative medicines. Government health programs are comprehensive and aim

at promoting a healthy lifestyle and disease prevention. The National Fitness Plan in China encourages and includes traditional national sports such as shuttlecock, dragon dance, cuqiu, lion dance, wooden ball, rubber band skipping, pearl ball etc. with intentions to encourage the citizens to be physically active.¹¹⁹ The Healthy China 2030 initiative is a progressive step with a focus on public health promotion and disease prevention and represents a strategic shift from the previous health systems approach that prioritized the management and treatment of diseases.¹²⁰ India recently launched a Nationwide fitness program under the aegis of the 'Fit India Movement' to bring about behavioral changes in reducing sedentary lifestyles and making fitness an integral part of the daily lives of its citizens. The 'Fit India Movement' is integrated within school health programs and provides provision for determining fitness levels, personalized tracking of steps, sleep, calorie intake and fitness plans through an established mobile application. India has also launched a National Multisectoral Action Plan for Prevention and Control of Common NCDs under four strategic areas Viz: integrated multisectoral coordination mechanisms, health promotion, health systems strengthening and surveillance, monitoring, evaluation, and research. Such comprehensive holistic national programs have also been initiated in other Asian countries such as Sri Lanka, Pakistan, Thailand, Malaysia, and Japan. These comprehensive culturally sensitive national programs are in line with global trends in promoting healthy living.

The current evidence base for the effectiveness of such strategies however is either weak or emerging but has strong acceptance among the local population. The availability of evidence is attributed to the low quality of existing research studies, indicating the need for rigorous large-scale, longitudinal studies that are designed with important population health metrics that are embedded within the project.¹²¹ Large-scale multi-centre trials on culturally sensitive interventions such as yoga are emerging and have indicated its beneficial effects in improving perceived health status and return to pre-infarct activities after acute myocardial infarction.¹²² Proven benefits of exercise training in the form of aerobic and resistance exercise is also gaining acceptance in Asian countries. WHO physical activity recommendations are being integrated within various National PA programs. The Exercise is Medicine initiative has its presence in 11 Asian countries. The challenges in Asia in tackling the rising burden of CVD are immense and need concerted action from all stake holders. The various National initiatives in the last decade are holistic and are in the right direction. The need for robust evidence on the effectiveness of such programs in controlling the CVD burden and improving overall health cannot be overemphasized. Towards this end, an international network such as HL-PIVOT can go a long way in strengthening collaborations, providing advocacy and augmenting government initiatives.²

Australia

CVD accounts for 26% of deaths annually in Australia. On average, 118 Australians die from CVD each day or one person every 12 min. Someone is hospitalized for CVD every minute, and this equates to a total of >1600 hospitalizations per day. If left unchecked, it is estimated that more than a million Australians will have prevalent CVD by the year 2029.¹²³ The prevalence of CVD is also inextricably linked with a significant economic cost with approximately \$5 billion spent each year on the provision of health care services to patients admitted with CVD.^{124,125} Further, the current incidence-based lifetime CVD cost estimates indicate a staggering \$28.2 billion in direct and \$32.3 billion in indirect costs for Australia.¹²⁶ Importantly, the prevalence of CVD and associated health conditions consequences are disproportionately higher in lower socioeconomic groups, Aboriginal and Torres Strait Islander (First nation) peoples, and those residing in geographically remote parts of the continent. Equity and access to preventive and/or cardiac rehabilitation initiatives are also seriously compromised for these sub-populations of Australian society.^{127,128}

Australia has had a checkered past with preventive health initiatives,¹²⁹ however, there has been a steady increase in attention paid to a collective approach to the prevention of CVD since the establishment of The National Prevention Task Force in 2008, and its various iterations since.¹³⁰ The most recent national-level initiative to curtail CVD, The National Strategic Action Plan for Heart Disease and Stroke, seeks to enlist the expertise of a wide range of stakeholder groups including healthcare professionals, researchers/academics, government, non-government organizations, the private sector, and community members, to enable all Australians to live healthier lives through effective prevention, treatment and management of heart disease and stroke.¹³¹ This current strategy incorporates prevention/early detection, diagnosis/treatment, support/ care, and research as priority areas with a reinvigorated emphasis on marginalized fractions of society. More specifically, the action plan advocates for consistency in visionary governance/leadership, multisectoral collaboration, workforce development, and improvements in health literacy/education standards, plus the appropriation of resources for meaningful data collection, research, and evaluation. Consistent with this aspirational plan is the significant \$220 million investment being made by multiple agencies for transformative improvements in heart and vascular health and stroke for Australians - the “Cardiovascular Health Mission”.¹³²

Contemporary efforts to prevent CVD in Australia are also characterized by ‘social determinants of health’ and more systemwide holistic approaches.¹³³ For example, over the last 2 decades, considerable progress has been made in laws/regulations and taxing/pricing policies that directly impact CVD incidence. Tobacco control laws that mandate businesses to provide smoke-free environments, enforce advertising restrictions, warning labels and point-of-sale controls and tax hikes for tobacco products, are all useful examples in this context.^{133,134} Mass media campaigns and social marketing approaches for targeted audiences and substantial investment in creating living environments conducive to healthy habitual behaviors have also received concerted attention.¹³⁵

There is also increasing recognition that many cases of CVD can be prevented. Interventions focusing on lifestyle modification to alleviate CVD risk factors such as sedentarism, sub-optimal nutrition, smoking and mental stress are all considered first-line approaches in the primary prevention of CVD.^{136,137} There are also many good examples of community-based interventions that incorporate lifestyle management strategies, including exercise/PA and nutritional approaches among the smorgasbord of CVD preventive actions undertaken in Australia to date.^{138,139} Collectively, various approaches have contributed to a considerable decline in deaths from CVD in recent decades. However, the fact that CVD remains the leading cause of death in Australia should be ample warning against any complacency and underscores the scale of work yet to be undertaken to improve CVD prevention.¹⁴⁰ The lingering high prevalence of CVD in Australia has led some to question the effectiveness of predominantly lifestyle-focused interventions with calls for the combination of simultaneous pharmaceutical intervention for added benefit.¹⁴¹ It is also possible that greater effort should be placed on improving the translation of research into practice, along with a better understanding of behavior change required in the prevention landscape, for meaningful reductions in CVD prevalence.^{142,143} To this end, some recent interventions have shown a proclivity for theory-based program development and user co-design to bridge the evidence-practice gap and improve the translatability of research findings to clinical management of CVD in Australia.¹⁴⁴

Although not yet completely elucidated, long-term sequelae of COVID-19 infection are linked with an array of cardiovascular complications including cerebrovascular disorders, dysrhythmias, ischemic and non-ischemic heart disease, pericarditis, myocarditis, heart failure and thromboembolic disease.¹⁴⁵ In the wake of the initial onslaught of COVID-19, several changes were recommended and subsequently implemented in the clinical care and management of CVD in Australia. This included staff upskilling, better resource allocation, novel therapies

and special precautions to minimize viral transmission in vulnerable individuals.¹⁴⁶ Nevertheless, the evolving nature of the COVID-19 pandemic provides an ongoing challenge and necessitates a fluidity in CVD management approaches.¹⁴⁷ It remains to be seen whether any of these circumstances will change the CVD prevention landscape in Australia in the post-COVID era.

Conclusion

At a time when the global health landscape has been impacted by the COVID-19 pandemic, which has resulted in damaged and disrupted economies but arguably and more importantly health systems, services, and priorities in a way never witnessed before. Therefore, the ability to plan and deliver and promote health initiatives that address the longstanding burden of chronic disease has also been impacted but the scale of these consequences has yet to be realized. This review highlights the extent of the challenge and burden of CVD, which has been exacerbated by the COVID-19 pandemic and must be addressed by targeted and collaborative initiatives that tackle our longstanding affiliation with unhealthy lifestyle behaviors.

Declaration of Competing Interest

None.

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