

Review article

Burden of illness, risk factor and physical activity in cardiovascular disease- A review

Shazia Neelam N., Saina Swathi, P. Senthil, Om Prakash P.

Chettinad School of Physiotherapy, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India

(Received: September 2022 Revised: July 2023 Accepted: August 2023)

Corresponding author: **P. Senthil**. Email: senthilp101010@gmail.com**ABSTRACT**

Cardiovascular illness encompasses a group of diseases affecting the blood vessels and the structure of the heart, and it remains one of the most prevalent non-communicable diseases worldwide. Over the years, the rate of death from cardiovascular diseases has shown a significant decline in several high-income countries, primarily due to reductions in risk factors and advancements in cardiovascular disease management. Nonetheless, the global burden of cardiovascular diseases remains substantial, with an estimated 55 million deaths occurring in 2017, out of which 17.7 million were attributed to cardiovascular disease. The focus of this review is to explore the burden of illness, risk factors, and physical activity levels in populations affected by cardiovascular diseases. Studies have identified 14 potentially modifiable risk factors that were strongly associated with cardiovascular disease and mortality, surpassing the significance of body mass index (BMI), as evidenced by the PURE (Prospective Urban and Rural Epidemiology) study and prior research. While cardiovascular deaths have decreased in several developed countries, there has been a significant increase in low- and middle-income countries. Physical activity has emerged as a critical factor in reducing the risk of mortality and major cardiovascular events, regardless of the type of physical activity and other risk factors. The Physical Activity Guidelines (PAG) for Americans in 2008 recommended a range of moderate and vigorous physical activity and highlighted its inverse association with all-cause mortality, cardiovascular disease mortality, and incident CVD. Emphasizing the importance of physical activity, this low-cost approach holds tremendous potential in reducing deaths and cardiovascular diseases on a global scale. Overall, this review highlights the ongoing global challenge of cardiovascular diseases and underscores the importance of preventive measures, including promoting physical activity, to improve cardiovascular health and reduce the burden of illness worldwide.

Keywords: Cardiovascular diseases; Air pollution; Physical activity in CVD; Risk of CVD; CVD prevalence.**INTRODUCTION**

Cardiovascular illness is a collective term that encompasses a group of diseases affecting the blood vessels and the structure of the heart (1). It stands as one of the most commonly reported non-communicable diseases globally. Some of the main types of cardiovascular diseases include: coronary artery disease (CAD), congenital heart disease and Cerebrovascular disease which includes conditions that affect the blood vessels in the brain, leading to strokes or transient ischemic attacks (TIAs), also known as mini-strokes.

Cardiovascular diseases pose significant health challenges worldwide and require comprehensive prevention, diagnosis, and management strategies to reduce their impact and improve overall public health (2). Atherosclerosis in the coronary arteries, which is the gradual build-up of plaque in the artery walls, can indeed be asymptomatic for a long time. This is a characteristic feature of coronary artery disease (CAD). Acute Coronary Syndrome (ACS), on the other hand, typically presents with symptoms due to a sudden blockage or rupture of a plaque in the coronary artery. ACS includes unstable angina and myocardial infarction (heart attack). Unstable angina is chest pain or discomfort that occurs at rest or with minimal exertion and is a warning sign of a possible heart

attack. Myocardial infarction occurs when there is a complete blockage of a coronary artery, leading to the death of heart muscle.

It is important to recognize the symptoms of ACS promptly to seek immediate medical attention as early intervention can be life-saving. Asymptomatic atherosclerosis in coronary arteries may be detected during routine health check-ups or diagnostic tests, and appropriate management can be initiated to reduce the risk of future cardiac events. Regular cardiovascular risk assessment and adherence to preventive measures are essential in managing both asymptomatic atherosclerosis and ACS Top of Form (3).

Bottom of Form

CAD is a major global cause of mortality, and its development is closely linked to endothelial dysfunction, inflammation, and the formation of atherosclerotic plaques (4). Heart Failure is a clinical condition characterized by structural and functional abnormalities in the myocardium, which impede the heart's ability to efficiently fill with or eject blood. Given its increasing prevalence and significant impact on mortality, heart failure stands as a notable cardiovascular disease (5).

The progression of such events is often expedited by factors such as diabetes, hypertension, smoking, and obesity. In several high-income countries, the death rate due to cardiovascular diseases experienced a decline starting from the mid-1970s. This improvement can be attributed to better management of cardiovascular illnesses and efforts to reduce risk factors (4). In 2016, India accounted for approximately 18.6% of the global burden of cardiovascular disease (CVD) as measured by disability-adjusted life years (DALYs). Out of an estimated 55 million deaths worldwide in 2017, CVD was responsible for 17.7 million deaths. While India's proportion of the global CVD burden is currently close to its share of the world's population (17.7% in 2015), this percentage is expected to rise in the future due to three primary factors.

First, India is projected to make the largest contribution to global population growth until at least 2050. With a rapidly growing population, the absolute number of CVD cases is expected to rise significantly. Secondly, India is currently experiencing notable demographic shifts, marked by an aging population and a steady rise in urbanization. The proportion of individuals aged over 60 years is projected to double from 8.9% to 19.4% between 2015 and 2050. Furthermore, the urban population in India is expected to grow from 30.9% in 2010 to 50.3% in 2050. These demographic changes are closely linked to an elevated risk of cardiovascular disease (CVD). Third, as living standards improve and socio-cultural transitions occur in India, there is a likelihood of more individuals adopting sedentary lifestyles and becoming obese. These lifestyle changes can lead to an increased prevalence of risk factors for CVD, such as hypertension, diabetes, and obesity.

Addressing the rising burden of CVD in India requires concerted efforts in preventive healthcare, promoting healthy lifestyles, and strengthening healthcare infrastructure to provide effective management and treatment for CVD. By implementing comprehensive strategies, India can better cope with the increasing impact of cardiovascular diseases and improve the health and well-being of its population (5). Individual and population level risk in a study investigation showed association with metabolic cluster of risk factors comprised high blood pressure, diabetes, hyperlipidaemia, obesity, education, grip strength and air pollution, 14 possible modifiable risk factors of which behavioural risk factors were tobacco consumption, alcohol intake, improper diet, less physical activity, and increased sodium intake are also associated with cardiovascular diseases mortality (6). There are other non-modifiable risk factors such as increasing age, male sex, genetics and parental history of CVD which may be considered when considering screening and intervention for potential CVD (7). The InterHeart study revealed that nine common risk

factors, including physical inactivity, improper diet, and psychosocial stress, accounted for more than 90% of acute myocardial infarctions (AMIs) in South Asians. Additionally, high homocysteine levels, ambient air pollution, outdoor temperature variations, psychosocial factors, mental health issues, and elevated high sensitivity C-reactive protein (hs CRP) levels indicating chronic infection and inflammation are also associated with a higher prevalence of coronary artery disease (CAD). Furthermore, Asian Indians experience mortality rates associated with CAD that are 20-50% higher than in other populations. To address this concern, preventive strategies should focus on general screening for conventional risk factors starting from a young age. Raising awareness and promoting lifestyle changes can effectively prevent or slow the progression of atherosclerosis (8).

In high-risk groups behavioural and lifestyle modifications including increased physical activity and proper diet have resulted in reduction of incidence of type 2 diabetes mellitus by 58% and significantly lowered systolic blood pressure between 5.4-11.4mmHg (9).

The Physical Activity Guidelines (PAG) for Americans in 2008 recommended a range of physical activity that could be achieved through 150 to 300 minutes per week of moderate-intensity physical activity, 75 to 150 minutes of vigorous-intensity physical activity, or a combination of moderate to vigorous physical activity. Studies have shown that engaging in moderate-to-vigorous physical activity per week is inversely associated with all-cause mortality, cardiovascular disease (CVD) mortality, and incident CVD.

The link between physical activity and reduced risks of mortality and cardiovascular disease (CVD) is consistently observed across major global regions and various countries' economic levels. Notably, research indicates that increasing physical activity is especially beneficial in lower-middle income countries and low-income countries, underscoring its potential advantages even in resource-constrained settings. Meeting the physical activity guidelines by engaging in activities such as walking for as little as 30 minutes on most days of the week has substantial health benefits. Moreover, higher levels of physical activity are associated with even lower risks of mortality and CVD.

Participating in physical activity, especially incorporating it into daily life, is a low-cost and accessible approach to reducing deaths and the burden of CVD. This low-cost and global applicability make physical activity a powerful tool in promoting public health and preventing cardiovascular diseases, offering a significant potential impact on a global scale. Encouraging individuals to engage in regular physical activity can have far-reaching benefits and

contribute to improved health outcomes worldwide (10).

METHODOLOGY

A comprehensive literature review was conducted to explore studies published in PubMed, Cochrane Library, ScienceDirect, and Google Scholar from the years 2013 to 2022. Relevant studies were carefully selected and included in this review. The selected studies underwent rigorous critical evaluation to

assess the burden of illness in terms of incidence and prevalence of cardiovascular diseases, as well as to examine the risk factors associated with these diseases. Additionally, the review also explored the levels of physical activity among the cardiovascular disease population. By analysing and synthesizing these findings, this review provides valuable insights into the current state of cardiovascular diseases and their associated risk factors and physical activity levels among affected individuals.

Table 1: Studies reviewed on incidence and prevalence

S.No	Author and year/reference number	Aim	Method	Conclusion
1.	Ralapanawa & Sivakanesan 2021(3)	A comprehensive review of epidemiological data on acute coronary syndrome (ACS) and coronary artery disease (CAD) reveals varying patterns across low, middle, and high-income countries.	The study period ranged from 2000 to 2019, excluding letters, editorials, conference abstracts, reviews, and comments from the analysis.	The absence of reliable epidemiological data estimation presents a barrier in several significant countries. Nevertheless, the globalization of sedentary lifestyles and Western dietary habits is believed to have contributed to an increase in the rate of coronary artery disease (CAD) in these nations.
2.	Yusuf <i>et al.</i> , 2014 (6)	To evaluate CVD risk in high-, middle- and low-income countries.	The Interheart Risk Score was employed to evaluate cardiovascular risk in 17 countries, comprising a mix of high, middle, and low-income nations. The study involved approximately 156,424 individuals from 628 urban and rural communities across these countries.	In high-income countries, the burden of cardiovascular disease (CVD) has been controlled through the implementation of improved risk reduction strategies, the adoption of proven pharmacologic therapies, and the widespread use of revascularization procedures. However, it is surprising that low-middle income countries, despite having lower risk factors, have experienced significantly higher rates of major CVD-related deaths compared to their high-income counterparts. This discrepancy highlights the complex and multifaceted nature of CVD, and the need for targeted efforts to address the unique challenges faced by different regions in tackling this global health issue.
3.	Geldsetzer <i>et al.</i> , in 2018 (7)	Determining CVD risk and factors varying among states in India.	A sample of 797,540 adults aged between 30 to 74 years was studied across India. The research focused on examining the prevalence of cardiovascular disease (CVD) risk factors in both rural and urban areas of the different states in the country.	Similar CVD risk pattern was noted across all 4 risk scoring systems among different states of India.
4.	Amini & Zayeri in 2021 (11)	The objective of this analysis is to examine the trends in cardiovascular disease (CVD) incidence, worldwide over a period of 28 years	This study collected age-standardized cardiovascular disease (CVD) mortality and incidence rates from the GBD Study 2017 for both genders covering the period	The study findings revealed that survival rates of CVD cases remained stable, coinciding with a decline in CVD events and death rates. Despite these positive trends, there is an urgent need to focus on enhancing the survival rate of patients and further reducing the burden of the disease in terms of both incidence and mortality. Additional efforts and

			from 1990 to 2017. The main objectives were to assess the mean trend of CVD incidence, mortality, and mortality-to-incidence ratio (MIR) across 195 countries. Additionally, the study aimed to elucidate the relationship between these indices and the Human Development Index (HDI) from 1990 to 2017.	interventions are required to address this pressing public health concern effectively.
5.	Einarson <i>et al.</i> , 2018 (12)	Estimate prevalence of CVD among adults with Type 2 diabetes mellitus.	A systematic search was conducted in the Medline, Embase, and proceedings of scientific original research databases to document the prevalence of Type 2 Diabetes Mellitus. No limitations were imposed regarding the country of origin or publication language. The data obtained from the search were then summarized descriptively.	Among individuals with Type 2 Diabetes Mellitus (T2DM), coronary artery disease (CAD) and Cerebrovascular Diseases (CVD) emerged as the leading causes of mortality. Globally, approximately 32.2% of all people with T2DM are affected by cardiovascular disease (CVD).
6.	Sarrafadegan & Mohammad ifard 2019 (13)	The objective of this study is to examine the trends in cardiovascular disease (CVD) prevalence, mortality, and morbidity, as well as to identify pertinent challenges and propose preventive measures for CVD.	Planning and implementing strategies to prevent CVD risks.	In Iran, it is imperative to prioritize strategies that concentrate on health promotion to prevent and control cardiovascular disease (CVD) risk factors. Early detection of the disease and effective management of both acute and chronic CVD events are also crucial in reducing the burden of illness associated with CVD. In recent years, there has been a notable increase in emphasis on planning and implementing comprehensive strategies for CVD prevention and control, making it a significant component of the country's health agenda.
7.	Yuyun <i>et al.</i> , 2020 (14)	This overview focuses on the descriptive epidemiology of cardiovascular diseases (CVDs) in Sub-Saharan Africa (SSA). It aims to provide a comprehensive understanding of the prevalence, distribution, and patterns of CVDs in this region.	To gather relevant information on cardiovascular diseases, non-communicable diseases, and various cardiovascular disease entities in Sub-Saharan Africa, a comprehensive search was conducted on PUBMED/Medline. Additionally, manual searches were performed through the bibliographies of	In Sub-Saharan Africa (SSA), cardiovascular disease (CVD) mortality disproportionately affects the youth compared to their counterparts in the Western world. This poses an additional risk to regional socioeconomic development and the sustainability of health systems. To tackle this challenge, a critical strategy involving primary prevention of CVD is necessary to effectively reduce the burden of morbidity and mortality in SSA. By focusing on preventive measures and promoting healthier lifestyles, the region can mitigate the impact of CVD and foster better long-term health outcomes

			pertinent articles. The search encompassed the period from January 1990 to March 2019.	for its population.
8.	CVD collaborators 2018 (15)	An extensive examination was conducted to analyze the shifting patterns of cardiovascular diseases and major risk factors across the states of India during the period from 1990 to 2016.	From 1990 to 2016, a comprehensive analysis was conducted to assess the prevalence and disability-adjusted life-years (DALYs) associated with cardiovascular diseases and their major component causes in the various states of India. The study aimed to gain a deeper understanding of the impact and burden of these diseases over the examined period.	The burden of ischemic heart disease and stroke shows significant variation among Indian states. The increasing prevalence of these diseases and associated risk factors underscores the urgent need for proactive measures from policymakers and healthcare providers. Tailored responses are essential to address the specific situation in each state in India effectively.
9.	Sarma <i>et al.</i> , 2019 (16)	To assess the prevalence of non-communicable disease (NCD) risk factors in Kerala, comprehensive surveys and studies are conducted.	In 2016-2017 a community based, cross-sectional survey was done as a multistage, cluster sample were collected of around 12012 (aged 18-69) among 14 districts of Kerala.	Most of the participants in the survey had more than one non-communicable disease risk factor, lower rates of hypertension and diabetes needs a strategy to address the future burden of NCDs.
10.	Mensah <i>et al.</i> , 2019 (17)	To develop appropriate regional patient prevention and management strategies across the globe.	15 most common causes of CVD deaths (including congenital heart defects) and 13 related risk factors are categorized, CVD risk factor data will be presented as the attributable deaths and attributable DALYs by age group, sex, year, and location.	Active engagement of the cardiology community is a critical factor in driving advancements in clinical practice, training, and research in global health. By fostering collaboration and communication among cardiologists and healthcare professionals worldwide, we can develop region-specific patient prevention and management strategies that address the unique needs and challenges faced by different populations.

Incidence and prevalence (Table 1)

According to the study conducted by Amini and Zayeri, the analysis of trends in cardiovascular diseases (CVD) incidence and death rates over 28 years showed a reduction in both incidence and mortality globally. When comparing developed and developing countries, the incidence of CVD in developed countries decreased by 14.4%, while in developing countries, it was only about 2.7%. Similarly, mortality rates also saw a reduction of about 23.8% in developed countries and 18.5% in developing countries. This disparity in reduction rates may be attributed to the adoption of effective prevention strategies and the rapid economic transition observed in developed nations. These findings underscore the significance of continued efforts to

implement and improve prevention strategies to further reduce the burden of CVD and promote global cardiovascular health.

Some studies revealed that the rate of death due to cardiovascular disease (CVD) is significantly higher in low-income countries compared to high-income countries. This difference may be attributed to factors like the adoption of western diets and reduced levels of physical activity in low-income countries. On the other hand, in high-income countries, the burden of CVD risk factors has been mitigated by effectively controlling these risk factors and widespread use of proven pharmacologic therapies and revascularization procedures. These strategies have contributed to reducing the impact of CVD and improving overall cardiovascular health in high-income countries.

However, addressing the disparities in CVD outcomes between low and high-income countries remains a crucial global health challenge, and further efforts are needed to implement effective prevention and management strategies in low-income settings. Among all the risk factors, the people with type 2 diabetes have the prevalence of CVDS of about 32.2% and it is also one of the major causes of mortality.

In countries like Iran, where rapid socio-demographic and economic transitions are occurring, cardiovascular disease (CVD) has emerged as the leading cause of mortality. This significant health burden has resulted in a million disability-adjusted life years (DALYs), accounting for 46% of all deaths and contributing to 20%-23% of the overall burden of disease. The rising prevalence of CVD in such countries underscores the urgent need for comprehensive and targeted strategies to address this growing health challenge. Implementing effective prevention and management measures for CVD is essential to improve population health outcomes and reduce the burden of disease in Iran and other countries experiencing similar socio-economic transitions. In low-income countries like those in Africa, non-communicable diseases (NCDs) have become the second leading cause of death. Among these NCD-related deaths, cardiovascular

diseases account for approximately 13%, constituting a significant portion, at 37%, of overall NCD deaths. The main obstacle hindering the effective primary and secondary prevention of cardiovascular diseases in these regions is the insufficiency of healthcare systems. Improving and strengthening healthcare infrastructure and resources are essential to enhance the prevention, diagnosis, and management of cardiovascular diseases, ultimately reducing the burden of NCDs and improving public health outcomes in low-income countries.

The Global Burden of Diseases, Injuries, and Risk Factors Study 2016 revealed the significant prevalence and disability-adjusted life-years (DALYs) attributed to cardiovascular diseases (CVDs) in the states of India. CVDs accounted for 28.1% of total deaths and 14.1% of total DALYs in the country, emphasizing their substantial impact on the health burden. These findings underscore the importance of implementing effective prevention and management strategies to address this critical public health issue. Notably, CVD risk tended to be highest in North, Northeast, and South India, while district-level wealth and urbanization showed a positive association with CVD risk.

Table 2: Studies reviewed on risk factors of cardiovascular diseases

S. no	Author and year/reference No.	Aim	Method	Conclusion
1.	Teo & Dokainish in 2017 (18)	To demonstrate relatively low rates of CV medicine use in high- and middle-income countries, but even lower rates in low-income countries.	The population-based Prospective Urban and Rural Epidemiological (PURE) study, which included more than 150,000 participants, also with a majority from developing countries.	The majority of cardiovascular disease (CVD) cases are observed in lower-income countries where the prevalence of CVD risk factors is increasing. While these risk factors are common globally, their control, prevention measures, lifestyle modifications, and outcomes have not been extensively implemented in lower- and middle-income countries (LMICs). To address the growing epidemic of CVD in these regions, targeted, systematic, sustained, and effective interventions are essential. By implementing such interventions, we can work towards alleviating the emerging burden of CVD and promoting better cardiovascular health outcomes in LMICs.
2.	Bays <i>et al.</i> , in 2021 (19)	To provide a summary of ten things to know about CVD risk factors and its application in preventive cardiology providing access to guidelines.	The summary document titled "ASPC Top Ten CVD Risk Factors 2021 Update" provides insights from the section authors regarding essential knowledge about ten significant cardiovascular disease (CVD)	The ASPC's "Ten things to know about ten cardiovascular disease risk factors - 2022" serves as an essential resource for individuals seeking a comprehensive approach to CVD prevention. Preventive cardiology is most effectively achieved through a collaborative team-based approach that involves a diverse group of healthcare professionals. Depending on the specific circumstances, this team may include clinicians, nurses, dietitians, pharmacists, educators, front-desk personnel, social workers, community

			risk factors. Additionally, the document offers convenient access to key references (pertinent guidelines and notable reviews) corresponding to each section on CVD risk factors.	health workers, psychologists, exercise physiologists, and other specialized healthcare professionals. By working together, this collective effort ensures a holistic and impactful approach to address the risk factors and improve cardiovascular health outcomes.
3.	Young and Cho 2019 (20)	The main focus is to address both conventional and distinct risk factors of cardiovascular disease (CVD) in women. This involves implementing sex-specific risk stratification and management approaches to cater more effectively to the specific needs and characteristics of women's cardiovascular health.	The ACC/AHA 2004 guidelines highlight the importance of early risk factor identification in women and the potential benefits of aggressive risk factor modification.	This proactive approach can begin as soon as pregnancy-related cardiovascular disease (CVD) risk factors or increased postmenopausal CVD risk are identified. By promptly detecting these risk factors, early intervention can be initiated, including lifestyle modifications through diet and exercise, and in some cases, drug treatment. This proactive approach is essential in reducing the lifetime risk of cardiovascular disease in women.
4.	Agarwal et al., 2020 (21)	It is important to emphasize sex-specific cardiovascular disease (CVD) risk factors in women and recognize the significance of eliciting a comprehensive obstetrical and gynaecological history during cardiovascular risk assessment.	This study highlighted sex-specific CVD risk factors in women, stress the importance of eliciting a thorough obstetrical and gynaecological history during cardiovascular risk assessment from 2018 American Heart Association/American College of Cardiology Multi-Society cholesterol guideline and 2019 American College of Cardiology/American Heart Association guideline on the primary prevention of CVD.	The current state of cardiovascular care for women falls short of the ideal standard. There is a need for a paradigm shift to address the underdiagnosis and undertreatment of cardiovascular disease (CVD) in women. This change requires a concerted and intensive effort from the cardiovascular community. By prioritizing gender-specific research, improving awareness, and implementing targeted interventions, we can significantly improve cardiovascular care for women and reduce the gender gap in CVD diagnosis and treatment.
5.	Bae et al., 2021 (22)	The research aims to examine the influence of cardiovascular disease (CVD) and its risk factors on fatal outcomes, with a specific focus on considering the age of patients with COVID-19.	A comprehensive systematic literature review and meta-analysis were performed, using data collected from PubMed and Embase databases	Although young patients have lower prevalence rates of cardiovascular comorbidities compared to elderly patients, they exhibit a higher relative risk of a fatal outcome if they have hypertension, diabetes, or cardiovascular disease (CVD) than elderly patients.

			up to 11 June 2020. The primary outcome measure evaluated was a composite of severe COVID-19 or death.	
6.	Harrison <i>et al.</i> , 2021 (23)	This study aims to consolidate evidence to assess two primary aspects: (i) the association between cardiovascular risk factors and health outcomes concerning coronavirus 2019 (COVID-19); and (ii) the impact of COVID-19 on cardiovascular health. By analyzing available data, the research seeks to provide insights into the relationship between COVID-19 and cardiovascular risk factors, as well as the potential effects of the virus on individuals with pre-existing cardiovascular conditions.	A comprehensive umbrella review of systematic reviews was conducted, covering data from fourteen medical databases and preprint servers. The search spanned from 1 January 2020 to 5 November 2020, aiming to collect comprehensive and current information on the chosen topic.	Identifying potentially modifiable risk factors associated with adverse outcomes of COVID-19 has been a significant focus. To enhance outcomes for individuals following COVID-19, implementing primary and secondary prevention strategies that target cardiovascular risk factors becomes crucial. By addressing modifiable risk factors like hypertension, diabetes, obesity, and smoking, healthcare interventions can greatly improve the prognosis and overall health of individuals in their recovery from COVID-19.
7.	Floras 2018 (24)	The primary objectives of this review are to investigate the bidirectional relationship between sleep-disordered breathing and cardiovascular disease.	Reviewed findings and implications of observational and randomized trials of treatment using keywords such as sleep apnea, heart failure.	The difficulty in achieving and sustaining effective treatment of Central Sleep Apnoea (CSA) with PAP devices has led to the exploration of alternative therapeutic approaches. These include aggressive diuresis, nocturnal supplementary oxygen, overdrive pacing, and transvenous phrenic nerve stimulation. Biventricular pacing has shown promise in acutely attenuating CSA by enhancing hemodynamic. However, in the long term, most patients still experience moderate to severe apnoea despite this intervention.
8.	Chrysant & Chrysant 2018 (25)	A collateral literature review presented in study data from the year 2010-2017.	Literature review was done between the year 2010-2017 using key words such as homocysteine, CVD, Stroke and 38 other papers with similar information were selected.	Studies showed association of homocysteine with incidence of CVD and stroke, also few studies showed association of homocysteine with atherosclerosis and CAD. A prospective placebo-controlled clinical trial needs to be definite about the level of homocysteine lowering and dose of folic acid.

Risk factors (Table 2)

Cardiovascular disease (CVD) and its associated risk factors pose an increasing challenge in developing or lower-income countries. While risk factors for CVD are prevalent worldwide, their control, prevention measures, and interventions, including adherence to lifestyle modifications, are notably lower in low-income countries. This disparity underscores the

urgent need for targeted and effective strategies to improve cardiovascular health in these regions. By addressing the barriers to risk factor control and implementing comprehensive preventive measures, we can work towards reducing the burden of CVD and promoting better cardiovascular outcomes in low-income countries.

According to the 2021 update report by the American Society for Preventive Cardiology (ASPC), the top ten cardiovascular disease risk factors are Improper diet, Physical inactivity, Dyslipidemia, Hyperglycemia, High blood pressure, Obesity, Factors related to specific populations, Thrombosis/smoking, Kidney dysfunction, Genetics/familial hypercholesterolemia (26, 27).

Identifying and addressing these risk factors are essential for effective preventive cardiology and reducing the burden of cardiovascular disease. Implementing targeted interventions and lifestyle modifications can significantly improve cardiovascular health and overall well-being.

Specific clinical conditions in women have shown an increase in CVD risks such as pre-eclampsia, gestational diabetes, PCODs, menopause and autoimmune diseases. Absolutely, obtaining a comprehensive obstetrical and gynaecological history during cardiovascular risk assessment is crucial. This information can provide valuable insights into the presence of sex-specific risk factors that may impact cardiovascular health in women. By identifying these unique risk factors early on, healthcare professionals can initiate appropriate and tailored preventive measures to mitigate the potential impact on cardiovascular health. Integrating sex-specific risk assessment into routine practice allows for more personalized and effective strategies in preventing and managing cardiovascular diseases in women.

Indeed, sleep apnea poses a clinically concealed threat to homeostatic cardiovascular rhythms and remains a mysterious cardiovascular risk factor. While some risk factors for sleep apnea are known, there may be other

contributing factors that are yet to be fully understood. Further studies are required to confirm and delve deeper into the complexities of sleep apnea and its impact on cardiovascular health. By gaining a better understanding of this condition and its associated risk factors, we can develop more effective prevention and management strategies to protect cardiovascular health and overall well-being. During the COVID-19 pandemic, cardiovascular disease (CVD) and its risk factors have emerged as significant contributors to deadly outcomes across all age groups. While young patients may have lower prevalence rates of cardiovascular-related health conditions compared to older patients, the relative risk of fatal outcomes in young patients with hypertension, diabetes, and CVD is higher than in elderly patients. This highlights the importance of recognizing and managing cardiovascular risk factors in all age groups, as they can significantly impact the severity and prognosis of COVID-19 cases.

Effective management and prevention strategies for CVD and its risk factors are crucial in mitigating the impact of the pandemic on overall public health. Various common modifiable risk factors are accredited as a reason for cardiovascular disease conditions and deaths. Small number of common modifiable risk factors are responsible for CVD incidence and mortality, while other factors such as hypertension, education, poor diet and air pollution vary by economic level. Strategies focussing on prevention of risk factor and CVD management has most effects on reducing the CVD and mortality globally.

Table 3: Studies reviewed on physical activity and cardiovascular diseases

S. No.	Author and year/ reference number	Aim	Method	Conclusion
1.	Jakovljevic 2018 (28)	Highlighting the effect of age on cardiovascular changes and adaptations to exercises.	Literature review on studies describing CVD changes and molecular adaptations to physical activity.	Preventing cardiovascular disease (CVD) and slowing down age-related decline in cardiovascular function, even in the absence of disease, have shown remarkable benefits, largely attributed to lifestyle factors like physical activity and diet. However, to enhance our understanding and develop effective approaches, further studies are required to identify necessary strategies and interventions that can effectively mitigate age-related cardiovascular changes and improve overall cardiovascular function in later life. These efforts hold great potential in promoting healthy aging and reducing the burden of CVD in the aging population

2.	Cheng et al., 2018 (29)	A dose-response meta-analysis was conducted in this study to summarise the evidence on relationship between the amount of leisure time PA and risk cardiovascular mortality.	PubMed, Embase, Scopus and Cochrane library was searched and a total of 44 studies comprising 1584181 participants was enrolled for this meta-analysis study.	There was a negative correlation with leisure time PA and presence of CVD in cardiovascular mortality regardless of age and gender. High intensity leisure time PA has more benefits than those of moderate intensity leisure time PA.
3.	Kim et al., 2020 (30)	Combining the effects of Physical activity and Air pollution on CVD.	189771 samples aged >40 years were examined and their physical activity was measured using a questionnaire. The ambient levels of particulate matter 10,2.5 were also estimated.	Moderate to vigorous physical activity among the CVD population grouped in high and low levels of PM 10 or PM2.5 showed reduced risk factors, and extended studies are needed to overcome the harmful effects of air pollution.
4.	Ozemek et al., 2018 (31)	Recent efforts have made significant progress in three key areas related to cardiovascular risk factors (CRF) and physical activity (PA): - Novel Analytic Techniques. - Long-term Compliance to PA Recommendations. - Potential Harms of Extreme PA volumes. Together, these recent research efforts contribute to a better understanding of cardiovascular risk factors, the importance of consistent physical activity, and the need for mindful exercise practices to optimize cardiovascular health.	Reviewed on collective investigative efforts, starting with the seminal works by Morris and Paffenbarger.	Recent studies discussed in this review, which investigate the associations between Cardiorespiratory Fitness (CRF), structured exercise training (ET), leisure physical activity (PA), and the risk of cardiovascular disease (CVD) and poor health outcomes, validate and expand upon prior research. These latest findings provide deeper insights into the long-term impact of maintaining CRF, engaging in exercise training, and participating in leisure PA on CVD outcomes, particularly through large-scale studies. To further advance our understanding and capitalize on these positive effects, future efforts must focus on developing effective interventions that encourage individuals to adhere to recommended PA levels, ultimately promoting and sustaining CRF. By implementing such interventions, we can proactively enhance cardiovascular health and improve overall health outcomes, building upon the evidence presented in these recent studies.
5.	Krist et al., 2020 (32)	Update of USPSTF 2014 recommendation on evidence of behavioural counselling promoting healthy diet and physical activity for CVD prevention.	The current recommendation of this report is applicable to populations aged 18 years and above with potential modifiable CVD risk factors or an estimated 10 year CVD risk of 7.5% or greater.	Primary care clinicians have various options for delivering behavioral counseling interventions to patients. They can offer in-person counseling sessions, refer patients to counseling interventions available in other settings, or inform patients about media-based interventions that can be beneficial for their health. These approaches provide opportunities for clinicians to support patients in adopting healthier behaviors

				and improving their overall well-being.
6.	Mattioli <i>et al.</i> , 2020 (33)	This analysis delves into the impact of quarantine on lifestyle, including aspects like nutrition, physical activity, and the adoption of new technologies as coping mechanisms. By exploring these dimensions, the study aims to provide a comprehensive understanding of how quarantine measures have influenced people's lifestyle choices, particularly regarding dietary habits and physical activity levels. Furthermore, it seeks to investigate the role of new technologies in offering innovative solutions to address the challenges posed by quarantine and facilitate healthier living during these unprecedented times.	Literature review of meta-analysis and RCT studies done on quarantine, diet and physical activity.	During and after quarantine, maintaining a healthy diet and engaging in regular physical activity at home is essential to support cardiovascular health. This assessment will help identify any potential risks and guide appropriate interventions to improve lifestyle choices. To foster a healthier lifestyle on a global scale, it is imperative to take collective action in supporting healthy diet and physical activity initiatives. By promoting awareness, providing accessible resources, and encouraging behavioural changes, we can create a positive impact on cardiovascular health and overall well-being for individuals worldwide.
7.	Cesa <i>et al.</i> , 2022 (34)	This study presents an updated meta-analysis of randomized clinical trials, expanding on the findings published in 2014. The primary goal is to assess the effects of physical activity interventions in preventing cardiovascular risk factors during childhood. Through the analysis of recent data, this research aims to offer a comprehensive understanding of the influence of physical activity interventions in promoting cardiovascular health and reducing risk factors in children.	For this study, a comprehensive search was performed on PubMed, EMBASE, and Cochrane CENTRAL databases. The inclusion criteria for randomized clinical trials (RCTs) involved physical activity interventions lasting longer than six months, targeting school children aged 6 to 12 years. The evaluation centered on assessing various cardiovascular risk factors, including body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol (TC), triglyceride (TG), as well as levels of low-density lipoprotein (LDL) and high-density lipoprotein (HDL).	The study findings indicated that six months of regular physical activity had beneficial effects, leading to reductions in systolic blood pressure (SBP), diastolic blood pressure (DBP), and triglyceride (TG) levels. Encouraging health promotion through regular physical activity in children and adolescents, especially during pubertal development, holds significant importance in fostering a healthy lifestyle throughout their lives. By instilling these habits early on, we can promote disease prevention and support overall well-being in the long term.
8.	Uthman <i>et al.</i> ,	The objective of this	In the year 2014, a	There was a reduction in BP, BMI

	2015 (35)	study is to assess the effectiveness of multiple risk factor interventions targeting major cardiovascular risk factors for primary prevention of cardiovascular disease (CVD) in low- and middle-income countries (LMICs).	comprehensive search was conducted, covering various databases such as Cochrane Library, Medline, Embase, Global health, and others. The search aimed to identify randomized controlled trials (RCTs) focusing on behavioral change interventions with or without pharmacological treatment among low- and middle-income countries (LMICs).	and waist circumference in LMICs population with high risk of Hypertension and diabetes through multiple risk factor intervention. However, in this study the group was heterogeneous with smaller trials. Larger studies with homogenous groups and longer follow up periods are wanted to confirm the intervention is as useful as shown in the studies.
9.	Lear <i>et al.</i> , 2017 (36)	This study aims to investigate whether varying amounts and types of physical activity are associated with lower mortality and reduced cardiovascular disease (CVD) risk in countries at different economic levels.	This prospective cohort study enrolled participants from 17 countries. Eligible individuals aged between 35 and 70 years, who planned to reside at their current address for at least another 4 years, were invited to participate in the study.	Both recreational and non-recreational physical activity were linked to a reduced risk of mortality and cardiovascular disease (CVD) events in individuals from both low- and high-income countries (LMICs and HICs). Emphasizing the importance of increasing physical activity, this straightforward, widely applicable, and cost-effective global strategy has the potential to significantly reduce deaths and lower the burden of CVD in middle age populations worldwide.

Physical activity (Table 3)

As individuals age, the cardiac system undergoes changes characterized by a gradual loss of cardiomyocytes and mild hypertrophy. Additionally, there is a reduced sensitivity to sympathetic stimuli, which can compromise myocardial contractility and pumping capability in older people. However, lifestyle factors such as physical activity play a pivotal role in improving muscular and cardiorespiratory fitness, as well as bone and functional health (37). These lifestyle interventions not only aid in preventing cardiovascular diseases but also contribute to achieving and maintaining good cardiovascular function throughout the aging process.

Previous studies suggest that engaging in moderate to vigorous intensity physical activity provides greater cardiovascular benefits and lowers the risk of cardiovascular disease (CVD). When examining the type of physical activity, participation in structured exercise programs, recreational activities, and leisure time physical activity has been linked to a reduced risk of CVD incidence and mortality in populations from low- and middle-income countries (LMICs). These findings underscore the importance of various forms

of physical activity in promoting cardiovascular health and alleviating the burden of CVD in these populations.

In addition to physical activity, primary care clinicians can play a crucial role in promoting better health outcomes and health status by offering in-person behavioural counselling interventions. Through these interventions, clinicians can assist patients in adopting, substituting, or maintaining behaviours that have been proven to positively impact their health. By providing personalized counselling and support, primary care clinicians can help patients make sustainable lifestyle changes that lead to improved overall health and well-being. During quarantine in pandemic situations, such as COVID-19, promoting a healthy diet and engaging in regular physical activity at home becomes crucial. Re-evaluating cardiovascular risk in patients through the assessment of biometrical and metabolic parameters is crucial to ensure their overall well-being.

Moreover, emphasizing regular physical activity classes in schools is essential for disease prevention and health promotion among children and adolescents, especially during pubertal development. Instilling

healthy habits during this crucial phase can yield long-term benefits, as these habits are more likely to be maintained throughout life. By giving priority to these initiatives, we can foster improved cardiovascular health and overall well-being among individuals of all age groups.

CONCLUSION

The Global Burden of Disease (GBD) report highlights a decline in cardiovascular disease mortality in high-income countries, which can be attributed to the advancements in healthcare facilities and the implementation of effective prevention strategies among the population. However, low and middle-income countries should prioritize the development of novel strategies and interventions that can attenuate age-related cardiovascular changes and enhance overall cardiovascular function later in life.

Furthermore, additional comprehensive studies are necessary to confirm the benefits of physical activity in counteracting the harmful effects of air pollution during physical activity. This information is crucial for designing appropriate guidelines and recommendations to promote physical activity while safeguarding individuals from the adverse effects of air pollution, particularly in regions with high pollution levels. By addressing these challenges, we can take significant steps towards improving cardiovascular health and enhancing overall well-being in populations worldwide.

CONFLICT OF INTEREST

There is no conflict of interest among authors.

REFERENCES

- Al-Hadidi, E. E., Al-Obaidi, W. M. Assessment of asprosin level and some of physiological variables in patients with cardiovascular diseases in Kirkuk city, Iraq. *Biomedicine*. 2022 Nov 14;42(5):973-977.
- Palmer, M. J., Barnard, S., Perel, P., Free, C. Mobile phone-based interventions for improving adherence to medication prescribed for the primary prevention of cardiovascular disease in adults. *The Cochrane Database of Systematic Reviews*. 2018; 6: CD012675.
- Ralapanawa, U., Sivakanesan, R. Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: A narrative review. *Journal of Epidemiology and Global Health*. 2021; 11(2): 169-177.
- Monisha, K. G., Prabhu, P., Chokkalingam, M., Murugesan, R., Milenkovic, D., Ahmed, S. Clinical utility of brain-derived neurotrophic factor as a biomarker with left ventricular echocardiographic indices for potential diagnosis of coronary artery disease. *Scientific Reports*. 2020; 10(1): 16359.
- Kaviarasan, V., Mohammed, V., Veerabathiran, R. Genetic predisposition study of heart failure and its association with cardiomyopathy. *The Egyptian Heart Journal: (EHJ): Official bulletin of the Egyptian Society of Cardiology*. 2022; 74(1):5.
- Yusuf, S., Rangarajan, S., Teo, K., Islam, S., Li, W., Liu, L., PURE investigators. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. *The New England Journal of Medicine*. 2014; 371(9): 818-827.
- Geldsetzer, P., Manne-Goehler, J., Theilmann, M., Davies, J. I., Awasthi, A., Danaei, G., Geographic and sociodemographic variation of cardiovascular disease risk in India: A cross-sectional study of 797,540 adults. *PLoS Medicine*. 2018; 15(6): e1002581.
- O'Donnell, M. J., Chin, S. L., Rangarajan, S., Xavier, D., Liu, L., Zhang, H., INTERSTROKE investigators. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): A case-control study. *Lancet (London, England)*. 2016; 388(10046): 761-775.
- Jagannathan, R., Patel, S.A., Ali, M.K., Narayan, K. M. V. Global updates on cardiovascular disease mortality trends and attribution of traditional risk factors. *Current Diabetes Reports*. 2019; 19(7): 44.
- Sreenivas Kumar, A., Sinha, N. Cardiovascular disease in India: A 360-degree overview. *Medical Journal, Armed Forces India*. 2020; 76(1): 1-3.
- Amini, M., Zayeri, F., Salehi, M. Trend analysis of cardiovascular disease mortality, incidence, and mortality-to-incidence ratio: Results from global burden of disease study 2017. *BMC Public Health*. 2021; 21(1): 401. .
- Einarson, T.R., Acs, A., Ludwig, C., Panton, U.H. Prevalence of cardiovascular disease in type 2 diabetes: A systematic literature review of scientific evidence from across the world in 2007-2017. *Cardiovascular Diabetology*. 2018; 17(1).
- Sarrafzadegan, N., Mohammadifard, N. Cardiovascular disease in Iran in the last 40 Years: Prevalence, mortality, morbidity, challenges and strategies for cardiovascular prevention. *Archives of Iranian Medicine*. 2019; 22(4): 204-210.
- Yuyun, M. F., Sliwa, K., Kengne, A. P., Mocumbi, A. O., Bukhman, G. Cardiovascular diseases in sub-Saharan Africa compared to high-income countries: An Epidemiological Perspective. *Global Heart*. 2020; 15(1): 15.
- India State-Level Disease Burden Initiative CVD Collaborators. The changing patterns of cardiovascular diseases and their risk factors in the states of India: The Global burden of disease study 1990-2016. *The Lancet. Global Health*. 2018; 6(12): e1339-e1351.
- Sarma, P. S., Sadanandan, R., Thulaseedharan, J. V., Soman, B., Srinivasan, K., Varma, R. P., Prevalence of risk factors of non-communicable diseases in Kerala, India: results of a cross-sectional study. *BMJ open*. 2019; 9(11): e027880.
- Mensah, G. A., Roth, G. A., Fuster, V. The global burden of cardiovascular diseases and risk factors: 2020 and beyond. *Journal of the American College of Cardiology*. 2019; 74(20): 2529-2532.
- Teo, K. K., Dokainish, H. The emerging epidemic of cardiovascular risk factors and atherosclerotic disease in developing countries. *The Canadian Journal of Cardiology*. 2017; 33(3): 358-365.
- Bays, H. E., Taub, P. R., Epstein, E., Michos, E. D., Ferraro, R. A., Bailey, A. L., Ten things to know about ten cardiovascular disease risk factors. *American Journal of Preventive Cardiology*. 2021; 5: 100149.
- Young, L., Cho, L. Unique cardiovascular risk factors in women. *Heart (British Cardiac Society)*. 2019; 105(21): 1656-1660.
- Agarwala, A., Michos, E. D., Samad, Z., Ballantyne, C. M., Virani, S. S. The use of sex-specific factors in the assessment of women's cardiovascular risk. *Circulation*. 2020; 141(7): 592-599.
- Bae, S., Kim, S.R., Kim, M.N., Shim, W. J., Park, S.M. Impact of cardiovascular disease and risk factors on fatal outcomes in patients with COVID-19 according to age: A systematic review and meta-analysis. *Heart (British Cardiac Society)*. 2021; 107(5): 373-380.
- Harrison, S. L., Buckley, B. J. R., Rivera-Caravaca, J. M., Zhang, J., Lip, G. Y. H. Cardiovascular risk factors,

- cardiovascular disease, and COVID-19: An umbrella review of systematic reviews. *European Heart Journal. Quality of Care & Clinical Outcomes*. 2021; 7(4): 330-339.
24. Floras, J. S. Sleep apnea and cardiovascular disease: An enigmatic risk factor. *Circulation Research*. 2018; 122(12): 1741-1764.
25. Chrysant, S. G., Chrysant, G. S. The current status of homocysteine as a risk factor for cardiovascular disease: a mini review. *Expert Review of Cardiovascular Therapy*. 2018; 16(8):559-565.
26. Jakovljevic, D. G. Physical activity and cardiovascular aging: Physiological and molecular insights. *Experimental Gerontology*. 2018; 109:67-74.
27. Chakraborty, A., Prabhu, M. M., Stanley, W. Improving the existing cardiovascular risk scoring systems for better prediction in type 2 diabetes mellitus with and without coronary artery disease: A cross sectional study. *Biomedicine*. 2021 Sep 7; 41(2): 454-457.
28. Rekha, J., Vasanthi, C., Thiagarajan, K. A., Arumugam, S. Impact of pedometer based physical activity on glycemic control and body composition of type 2 diabetes mellitus patients. *Biomedicine*. 2020 Nov 11; 40(2): 241-245.
29. Cheng, W., Zhang, Z., Cheng, W., Yang, C., Diao, L., Liu, W. Associations of leisure-time physical activity with cardiovascular mortality: A systematic review and meta-analysis of 44 prospective cohort studies. *European Journal of Preventive Cardiology*. 2018; 25(17):1864-1872.
30. Kim, S. R., Choi, S., Keum, N., Park, S. M. Combined effects of physical activity and air pollution on cardiovascular disease: A population-based study. *Journal of the American Heart Association*. 2020; 9(11): e013611.
31. Ozemek, C., Laddu, D. R., Lavie, C. J., Claeys, H., Kaminsky, L. A., Ross, R., An update on the role of cardiorespiratory fitness, structured exercise and lifestyle physical activity in preventing cardiovascular disease and health risk. *Progress in Cardiovascular Diseases*. 2018; 61(5-6): 484-490.
32. US Preventive Services Task Force, Krist, A. H., Davidson, K. W., Mangione, C. M., Barry, M. J., Cabana, M., Caughey, A. B., Behavioral counseling interventions to promote a healthy diet and physical activity for cardiovascular disease prevention in adults with cardiovascular risk factors: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2020;324(20): 2069-2075.
33. Mattioli, A. V., Sciomer, S., Cocchi, C., Maffei, S., Gallina, S. Quarantine during COVID-19 outbreak: Changes in diet and physical activity increase the risk of cardiovascular disease. *Nutrition, Metabolism, and cardiovascular diseases: NMCD*. 2020; 30(9):1409-1417.
34. Cesa, C. C., Sbruzzi, G., Ribeiro, R. A., Barbiero, S. M., de Oliveira Petkowicz, R., Eibel, B., Physical activity and cardiovascular risk factors in children: Meta-analysis of randomized clinical trials. *Preventive Medicine*. 2014; 69:54-62.
35. Uthman, O. A., Hartley, L., Rees, K., Taylor, F., Ebrahim, S., Clarke, A. Multiple risk factor interventions for primary prevention of cardiovascular disease in low- and middle-income countries. *The Cochrane Database of Systematic Reviews*. 2015; 8: CD011163.
36. Lear, S. A., Hu, W., Rangarajan, S., Gasevic, D., Leong, D., Iqbal, R., The effect of physical activity on mortality and cardiovascular disease in 130000 people from 17 high-income, middle-income, and low-income countries: The PURE study. *The Lancet*. 2017;390 (10113): 2643-2654.
37. Sananta, P., Ariyanti, N. T., Widasmara, D., Fuzianingsih, E. N. Is there any correlation between physical activity and severity of knee osteoarthritis in secondary referral hospitals in Indonesia?. *Biomedicine*. 2022 Nov 14; 42(5): 1014-1017.