Review Article

Social, Economic, Technological, and Environmental Factors Affecting Cardiovascular Diseases: A Systematic Review and Thematic Analysis

Abstract

Background: Today, cardiovascular disease (CVD) is the leading cause of mortality in both sexes. There are several risk factors for heart diseases; some controllable, others not. However, socioeconomic, technological, and environmental factors can impact CVD as well as exclusive risk factors. Accurate identification and assessment of these factors are often difficult. In the present systematic review, we aimed to explore factors affecting CVD. **Methods:** Multiple databases (MEDLINE, Scopus, ISI Web of Science, and Cochrane) and gray literature were searched. The included studies described at least one determinant of CVD. The framework method was applied to analyze the qualitative data. **Results:** A total of 64 studies from 26 countries were included. The contextual determinants of CVD were categorized into 45 determinants, 15 factors, and 4 main social, economic, technological, and environmental categories. The 15 potentially reversible factors were identified as sociodemographic, violence, smoking, occupation, positive childhood experience, social inequalities, psychological distress, eating habits, neighborhood, family income, rapid technology, environmental pollution, living environments, noise, and disaster. **Conclusions:** Devolution and more efficient health policies are required to achieve further sustained reduction in CVD mortality, increase life expectancy, and reduce its associated risk factors. Policymakers should fully address the value of social, economic, technological, and environmental factors. In fact, a prevention agenda should be developed and updated collaboratively in terms of the determinant factors.

Keywords: *Cardiovascular disease, economic, environmental, health system, social, technology*

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Introduction

According to the Global Burden of Disease Study's report,[1-3] noncommunicable diseases (NCDs) are the leading cause of mortality worldwide.[4] The four main NCDs are cardiovascular diseases (CVD), cancers, respiratory diseases, and diabetes.[5] Cardiovascular diseases remain the main cause of premature death and disability worldwide.[6] The number of CVD-related deaths is expected to rise to 23.3 million by the year 2030.[7] Furthermore, by 2030, medical burdens of CVD are predicted to increase by about 100%.[8,9] The CVD risk factors were categorized into two groups of behavioral and metabolic risk factors. Behavioral risk factors include unhealthy diets (salty food, fat, and sugars), physical inactivity, addiction to alcohol and tobacco, high body mass index (BMI) and waist-to-hip ratio. Metabolic risk factors include hyperglycemia, hyperlipidemia, inflammation, and raised blood pressure.[10,11] Moreover, socioeconomic discriminations, psychosocial stress, living in deprived conditions, and risky behaviors are associated with NCDs.[12] A systematic review revealed that in many countries, the low socioeconomic status factors were drinking alcohol, tobacco use, and insufficient consumption of fruits and vegetables. The socioeconomic factors were inactivity and consuming excess fat, salt, and processed food.[13] The results of some studies showed that having high-quality social relationships was linked to decreased health risks (e.g., immune functioning, cardiovascular functioning, and cognitive decline), while experiencing low-quality social relationships increased the risks.[14-16] Actually, risk factors for NCDs are multi-dimensional, comprising biological, social, behavioral, economic, and environmental factors.[17] Therefore, political, social, cultural, and economic issues need to be considered in the prevention and control of NCDs.[18]

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Prevention programs such as the "25 by 25" campaign aim to reduce premature mortality from CVD by 25% by 2025.[19] In fact, they focus on reducing behavioral and metabolic influences on the risk of CVD, but the long-term success of such lifestyle-related decision-making is multifactorial.[20] However, the prevention of CVD risk factors is a high-ranking priority for all health policy planners.[21] Nevertheless, an understanding of the community and household determinants of major cardiovascular risk factors, which may vary by geographical region and cultural background, is needed to develop prevention strategies. For instance, context-dependent strategies must be evaluated to ensure their efficiency.[22] Furthermore, interventions are needed to decrease barriers to cardiovascular healthiness. These strategies must encompass family and community contexts, small groups, interactive methods, culturally sensitive materials, and valid data sources.[23]

Therefore, the aim of this study was to review the social, economic, technological, and environmental factors of CVDs. The result of this review can help policymakers and health managers in the decision-making process to develop effective interventions for CVD patients.

Methods

Study design

Using a systematic review method, this study was conducted to review published studies that had investigated the determinants of CVD.

Search strategy

A comprehensive database search for qualitative and quantitative studies and expert opinions between 2002 and 2019 was carried out in PubMed, Scopus, ISI Web of Science, and Cochrane. Reference lists of other reviews were hand-searched to find additional studies. The following keywords were searched: factors, strategy, driver, driving force, cardiovascular diseases, non-communicable diseases, heart attack, myocardial infarction, control, prevention, social, technological, environmental, economic, socio-cultural and ecological. The full search strategy has been provided as supplementary material. Where possible, authors were contacted to obtain full-text publications of relevant abstracts. Studies published only as an abstract were excluded. The search strategy proposed for the PubMed database is shown in Table 1. With some modifications, this strategy was used for the other databases as well.

Study inclusion criteria

Published studies associated with CVD and studies that described at least one CVD determinant were included. Conference paper abstracts (where full analysis was not available), case reports, and studies with low quality in methodology, based on the Joanna Briggs Institute (JBI) checklist,[24] were excluded.

Table 1: Search strategy for the PubMed database

Search string	Record
"Search (((((((((Social[Title/Abstract]) OR cultural[Title/Abstract]) OR socio-cultural[Title/Abstract]) OR Technological[Title/Abstract]) OR Economic[Title/Abstract]) OR Political[Title/Abstract]) OR ecological[Title/Abstract])) AND (((((((factor[Title/Abstract]) OR driver[Title/Abstract]) OR strategy[Title/Abstract]) OR policy[Title/Abstract])) AND (((Cardiovascular disease[Title/Abstract]) OR heart attack[Title/Abstract]) OR myocardial infarction[Title/Abstract])) AND prevention[Title/Abstract])"	472

Study selection process

The title and abstract of each article were reviewed independently by two reviewers. The full texts of the studies were then retrieved and independently assessed for inclusion or exclusion by the reviewers. Disagreements on the eligibility of studies were resolved either through discussion between the reviewers or by a third party.

Assessment of the studies' reporting quality

The reporting qualities of the studies were evaluated by the JBI checklist. The JBI critical appraisal checklist is not intended to be used as a scoring system to determine the grade of the study, but to evaluate the risk of bias. The checklists consist of items that assess selection, performance, detection, and attrition bias, as well as trial designs. Items in the two checklists have four possible responses: "yes," "no," "unclear," and "inapplicable." Studies were excluded if they received less than four "yes" ratings in the Randomized Controlled Trial (RCT) and non-RCT checklists. Any disagreements on appraisal were resolved through discussion. Furthermore, the reviewers resolved their disagreements on study inclusion by arbitration and/or by a third reviewer. Full-text retrieval was performed for studies that met all prespecified inclusion criteria.

Data extraction, synthesis, and analysis

Considering the fact that this study was examining determinants, any article that referred to even one determinant was included. For example, articles that examined the impact of stress on CVD were included. Data on texts were extracted for quantitative studies. The extracted data included author, country, publication year, study description, objective, and results. The PRISMA flow diagram was used to select the included studies.

The analysis consisted of two steps. First, the characteristics of the studies were summarized by author, country, publication year, study description, objective, and results. The selected studies were fully reviewed, and the required data were extracted. Second, study results with particular focus on the determinant factors of CVD formed the basis of the descriptive factors. The Endnote X7 software was

Table 2: Characteristics of the studies included in the qualitative synthesis

Characteristic	No. of Studies (percent)	Characteristic	No. of Studies (percent)
Country		Method	
USA	12 (18.8%)	Cohort	33 (51.6%)
UK	10 (15.6%)	Cross-sectional	27 (42.2%)
Greece	5 (7.8%)	Case-control	2 (3.1%)
Others*	37 (57.8%)	Clinical trial	2 (3.1%)
Publication year		Samples	
2002-2004	8 (12.5%)	Men and women	51 (79.7%)
2005-2007	12 (18.8%)	Men	5 (7.8%)
2008-2010	8 (12.5%)	Women	6 (9.4%)
2011-2013	16 (25%)	Children	2 (3.1%)
2014-2016	12 (18.8%)		
2017-2019	8 (12.5%)		
Sample size		Data collection duration (years)	
>100	4 (6.3%)	1-10	48 (75%)
101-1000	11 (17.2%)	11-20	7 (10.9%)
1001-10000	28 (43.8%)	31-40	2 (3.1%)
10001-100000	19 (29.7%)	41-50	1 (1.6%)
<100001	2 (3.1%)	Not reported	6 (9.4%)

*Brazil, Finland, South Africa, Switzerland, Bosnia and Herzegovina, China, Italy, Germany, Canada, Denmark, South Korea, Belgium, Slovakian, Spain, India, Scotland, Netherlands, France, Sweden, Australia, Kenya, Bangladesh, and Norway

used to organize the studies, read the titles and abstracts, and identify duplicates.

Results

Study selection and characteristics

In the initial search, 5332 studies were identified. After screening the studies using the exclusion criteria, 274 studies were selected. Utilizing the reviews of the full texts, 210 studies were excluded from the study. However, studies were not omitted due to low methodology quality, which was checked using the JBI checklist. Finally, 64 studies were reviewed which had examined the determinants of CVD. Figure 1 presents the results of this systematic review.

Qualitative outcomes

Details of the studies' characteristics were provided as supplementary material. The 64 included studies were of different designs: 2 clinical trials,[25,26] 2 case-controls,[27,28] 27 cross-sectional studies,[29-51] and 33 cohorts.[52-85] The cohort methodology was implemented in most of the articles (51.6%). Most of the studies were from the USA (18.8%) and were published between 2011 and 2013 (25%). In addition, most studies had examined both sexes (79.7%). The longest follow-up period was 49 years. Most of the data were collected in a period of 1 to 10 years (75%) and the majority had a sample size ≥1000 (43.8%) [Table 2].

A total of 15 factors and 45 determinants were identified in 4 main categories. The 4 categories were identified as social, economic, technological, and environmental. The 15 factors were identified as sociodemographic, violence, smoking, occupation, positive childhood experience, social inequalities, psychological distress, eating habits, neighborhood, family income, rapid technology, environmental pollution, living environments, noise, and disaster. The determinants were described and the number of studies was indicated. Table 3 includes categories, factors, determinants, and contributing studies.

Most determinants belonged to the social category, whereas the economic and technological categories consisted of the least number of determinants. In the social category, determinants were related to demographics, psychological and childhood conditions, type of diet, and dietary habits. Moreover, the emphasis was more on the impact of neighbors and social mechanisms. In addition, the inequality and inappropriate distribution of income at the individual and community level can lead to CVD. Air pollution and the structure of the living environment in terms of access to recreational facilities and physical activity are important. These factors are intermingled and can have bilateral or multilateral interactions. For example, violence during childhood and in the family exacerbates the increase in mental illnesses and can consequently cause CVD. Conceptual relationships between categories, factors, and determinants are presented in Figure 2.

Discussion

Determinants that cause CVD can also affect traditional risk factors. A total of 45 determinants were identified;
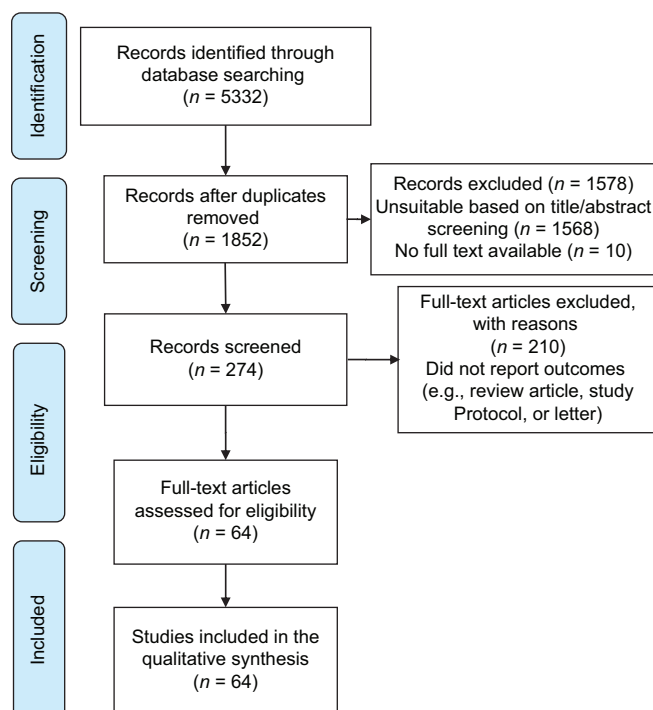
Figure 1: PRISMA Flow diagram of the included studies

the majority of these factors belonged to the social category. Based on this review's results, it seems that childhood, neighborhood, living environment, and social mechanisms are particularly important. Adopted health policies greatly impact the risk factors of illnesses and, eventually, the incidence of the disease. Political decisions and policymaking processes are influential in all areas, especially in the field of disease risk factors. In this regard, CVD can be affected by all functions of the health system which makes accessibility of care vitally important. Policies on physical education, transportation, food, work, green spaces, recreational facilities, and tobacco are crucial in this regard. In sum, the working environments, constructed environments, residential environments, urban forms, and green spaces are affected by policies and politics.

The social determinants of health are tools that help reveal how social processes interact globally, nationally, and individually with CVD.[86] The Isfahan Healthy Heart Program revealed a correlation between smokers and three socioeconomic status (SES) determinants: employment, occupation, and income.[87] Findings from population-based studies indicated the existence of an association between CVD and certain occupational factors and health behaviors and occupational groups (e.g. smoking, status, etc.).[88] In industrialized countries, cardiovascular mortality is inversely correlated with socioeconomic level and type of occupation. The work environment can play an important role, including psychological stress, sedentary jobs, passive smoking, and shift work.[89] Job stress, such as job strain and long working hours, is associated with a moderately high risk of coronary heart disease and strokes in Europe, the

United States, and Japan.[90] Findings from a meta-analysis suggest that workplace stress prevention could decrease the incidence of CVD.[91] Even so, prevention of workplace stress would have a much smaller impact than standard risk factors such as smoking, etc.

Inappropriate socioeconomic conditions during childhood are associated with the risk of ischemic stroke, regardless of identified risk factors and adult SES.[92] Evidence suggests that during pregnancy, the physiological state of a mother predisposes her new-born to adult diseases such as heart disease and stroke.[93] Strong and consistent evidence, however, indicates that parental, social, childhood, and early life influences and inequalities in health services often lead to an increased risk of CVD in people living in high-income countries with low socioeconomic backgrounds.[94] Childhood deprivation, marked by violence, neglect, and instability in the home, is a phenomenon that has a profound effect on individuals, communities, and society.[95] Adverse experiences in children may be related to high rates of anxiety and lack of sufficient care, contributing to increased risk of adverse coping mechanisms. Adverse experiences of childhood can influence emotional and psychological development and increase susceptibility to mental health issues such as major depression and post-traumatic stress disorder (PTSD), correlated with CVD risk factors. Early-life adversity can also change biological performance in stress management pathways and lead to long-term adult stress responses.[96] In high-income countries, the high prevalence of several behavioral and psycho-social risk factors among people with low SES reveals an inverse association of SES with the risk of CVD.[94] In fact, poverty has been considered as one of the most important social determinants of heart disease worldwide.[97] The Marmot Review results highlight that people living in England's poorest neighborhoods will die 7 years earlier on average than people living in the richest neighborhoods. Also the social gradient of health inequalities shows that the lower is the one's social and economic status, the poorer is the one's health.[98] Socioeconomic deprivation is a strong independent indicator of the risk for heart failure and its adverse effects.[99] The sociodemographic determinants of sudden cardiac deaths include lower SES, position in a social organization, social support, social exclusion and inequities, marital status, the role of employment, and stressful economic and social conditions.[100] Three dimensions of social support have been distinguished: (a) emotional support offered by family members and other close people can improve self-esteem and strengthen the sense of identity; (b) support for evaluation, knowledge, advice, and guidance in difficult situations; (c) concrete support for practical assistance.[101] All three dimensions are essential in order to maintain good cardiovascular health.

Depression can increase the risk of chronic heart disorders and death, either through direct pathophysiological mechanisms such as ventricular arrhythmias or by

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Table 3: Illustrative categories, factors, determinants and contributing studies

Category	Factor	Determinant
Social	Sociodemographic	Living in urban areas
		Sex, race, and age
		High school education, college-education
	Violence	Early abuse
		Partner violence
	Smoking	Tobacco consumption
		Second hand smoke
	Occupation	Job strain
		Job insecurity
		Occupational social class
		Job stress (work demand and decision latitude)
		Workplace bullying
	Positive childhood experience	Childhood socioeconomic status (parents' occupational status, primary education, secondary education, academic degree, family income, and occupational stability).
		Time spent outdoors
		Media exposure
		Positive home environment
		Under-nutrition (Early life)
	Social inequalities	Educational class inequalities
		Socioeconomic deprivation
	Psychological distress	Depression
		Anxiety
	Eating habits	Breakfast routine
		Mediterranean diet
		Intake of dietary fiber
	Neighborhood	Social disorganization, racial/ethnic minority concentration, urbanization
		Neighborhood-level deprivation
	Others	Tooth loss
		Loneliness
		Living in Slum
Economical	Family income	Annual family income
		Income inequality
Technological	Rapid technology	Modernization
		Industrialization
		Urbanization
		Use of radiotherapy for cancer
Environmental	Environmental pollution	Air pollution
		Vitamin D
		Particulate Matter of <2.5 μm in aerodynamic diameter (PM2.5)
	Living environments	Built environment
		Neighborhood greenness
		Intensity of oil and natural gas activity
		Traffic
	Noise	Aircraft noise
		Noisy roads and railways
	Disaster	Natural disaster

behavioral mechanisms.[102] Chronic stress shifts the homeostatic balance with sustained sympathetic overdrive and decreased vagal tone in the autonomic nervous system. Regardless of the involvement or absence of depression, inflammation occurs in neurological, gastrointestinal, and cerebrovascular pathology. Endothelial dysfunction, a preamble to atherosclerosis and atherothrombosis, is closely associated with inflammation. Endothelial dysfunction was observed in depression, which may be a characteristic marker for this disorder.[103] Nonetheless, social support can predict improvements in CVD patients.[48] In contrast, the combination of social isolation and depression worsens the prognosis and accelerates the progression of CVD.[104,105]
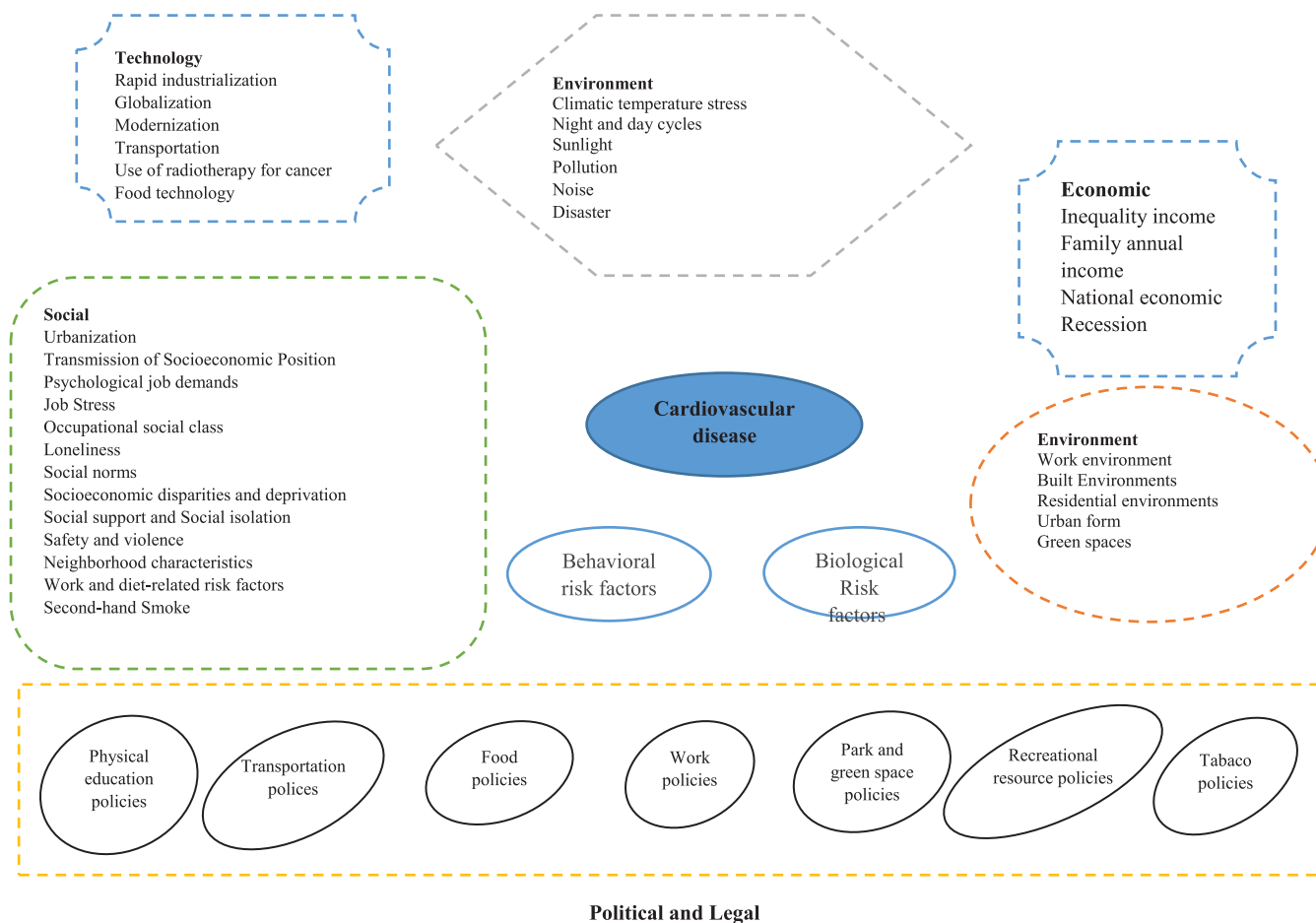
Figure 2: Conceptual relationships between categories, factors, determinants, and cardiovascular disease

In developing countries, urbanization has become a concern, as it affects the prevalence of risk factors for cardiovascular diseases.[106] Psycho-social and behavioral mechanisms mediate the effects of the factors associated with urbanization on the risk of NCD mortality.[107] For the CVD, it was explained that there are macro-social forces such as urbanization that affect the prevalence of major risk factors (i.e., dietary quality and tobacco use), which in turn are distributed differently within social groups. Furthermore, stressors in urban environments (noise, social isolation, and anxiety) were linked with the development of cardiovascular risk factors (hypertension and atherosclerosis).[108] Due to urbanization, behavioral and environmental changes may increase the risk of CVD.[109] Individual geographical location also affects CVD development. Living in the countryside, surrounded by meadows, trees, flowers, and plains is quite different from living in the city, where people suffer from traffic jams and noise pollution.[110] Moreover, according to the World Health Organization, air pollution and traffic noise are the two major environmental pollutants that affect health. In 2010, the American Heart Association reported that cumulative evidence regarding air pollution was consistent with the causal relationship

between exposure to $PM_{2.5}$ and cardiovascular morbidity and mortality.[111] Similarly, low neighborhood SES can influence myocardial infarction (MI) survival through inadequate leisure-time physical activity. Therefore, an intermediate mechanism between neighborhood SES and post-MI outcome is revealed and it can provide opportunities for prevention.[112] In addition, living in a deprived area often impacts CVD survivors, placing them at a higher risk of frequent hospital admissions.

It may be more helpful to consider a chronic disease as an "eco-disease," with its environmental and behavioral contributors, and consider nutritionally dependent chronic diseases as "eco-nutritional diseases."[113] Furthermore, socioeconomic and psychosocial factors exert influence on health, and also the development, progression, and prevention of diseases.[114,115] Scientific evidence suggests that low SES, social isolation, psychosocial stress, hostility, and depression have a negative effect on CVD. Recommendations for promoting behavioral changes and the management of psychosocial and lifestyle factors in clinical practice include strategies for promoting a healthy lifestyle, improving interactions between healthcare providers and patients, implementing multimodal interventions, and managing psychosocial risk

factors. Factors other than the major risk factors should be considered in health policies such as education, local governments, sports and recreational organizations, health services, mass media, and public departments.

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Conflicts of interest

There are no conflicts of interest.

Authors' contributions

GA, KG, RD, and RK contributed to the conception and/or design of the work. MA, KG, RK, and SA contributed to the acquisition, analysis, and/or interpretation of the data. MA and GA drafted the manuscript. RK, KG, SA, and GA critically revised the manuscript. All gave final approval and agreed to be accountable for all aspects of the work, ensuring integrity and accuracy.

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