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Review

Effect of Community and Socio-Economic Factors on Cardiovascular, Cancer and Cardio-Oncology Patients with COVID-19

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Abstract: The Coronavirus Disease 2019 (COVID-19) is a world-wide health crisis on a scale that has not been witnessed in modern times. Socio-economic (SE) factors impact every facet of human existence, including lifestyle, which significantly affects health-related quality of life. This article compiles major studies and discusses health disparities based on SE and community status in cardiovascular and cancer patients with a special focus on cardio-oncology in the context of COVID-19.

Keywords: cardiovascular disease (CVD); Coronavirus Disease 2019 (COVID-19); socio-economic (SE)

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1. Introduction

Socio-economic status (SE) and cultural disparities significantly influence the risk of non-communicable diseases and their associated morbidity/mortality [1]. Cardiovascular disease (CVD) and cancer are the top two leading causes of mortality globally and often occur together in the same patients [2]. CVD incidence, progression, morbidity, and mortality are influenced by a complex interplay between economic, cultural, social, geographic, institutional, and historical disparities. Whether measured by income, educational achievement, or occupation, such disparities also influence cancer outcomes [2–26]. The Coronavirus Disease 2019 (COVID-19) pandemic has significantly amplified these cultural–socio-economic disparities and brought them to the attention of most healthcare professionals and the general public [27]. This article discusses cardiovascular health disparities based on SE and community status in the context of COVID-19, with a particular focus on oncological patients. The literature review was conducted through a systematic

search using PubMed with keywords including COVID-19, SE factors, cardiovascular health, cancer, and cardio-oncology.

2. Community and Socio-Economic Factors Affecting Health Disparity

Social and economic factors include non-medical conditions such as education, food, shelter, sanitation, money, and transportation that affect the quality of life. Financial stability, education level, health care access, environment, and social and community factors influence health in powerful ways [28]. Neighborhoods' characteristics reinforce SE and ethnic disparities through physical features such as air and water quality, proximity to medical care facilities, employment resources, access to nutritious foods, and safe places to exercise [29]. Physically inactive workers in sedentary jobs are at an increased risk of obesity and chronic diseases, including diabetes, hypertension, and CVD [30]. In the workplace, psychosocial aspects such as social support and a mutually respectful environment may buffer against physical and mental health stressors [31]. A higher educational level has been associated with health-promoting behaviors, including better health-related decisions and timely adopting of health-related recommendations. Literacy is also associated with better living conditions and economic stability, which enhances positive health outcomes [32]. Economic factors affect access to material goods and services, including food, shelter, education, and health resources. Many longitudinal studies detail that adequate financial resources are associated with improved health or its determinants, even after adjustment for education [33]. Race or ethnic group is another essential social factor influencing health [34]. Deep-seated societal structures and overt and intentionally discriminatory actions and attitudes can constrain opportunities and resources based on an individual's race or ethnic group. Latinos and Blacks are more likely to reside in neighborhoods with inadequately resourced schools and hence have lower educational attainment and quality, with resultant adverse health effects as discussed above [34].

Studies show that social and financial hardship induces long-term stress via disrupting neuroendocrine, inflammatory, immune, and vascular functions [35]. During a stress response, the release of cortisol, cytokines, and other neuro-modulatory substances can adversely affect immune defenses and physiologic systems [35]. Many biological risk factors for CVD vary with SE status and are influenced by the interaction of neuroendocrine and autonomic pathways [35]. Epidemiological studies have shown an association between biological markers of CVD risk and psychosocial factors, including excessive work, social isolation, depression, and hostility [35]. These associations can be taken as positive evidence for the role of psychobiological pathways in mediating risk variations. This stress-related pathophysiological phenomenon can precipitate the onset or progression of chronic diseases [35]. Thus, allostatic load, referred to as the cumulative burden of chronic stress and life events, is shown to be associated with poorer health outcomes beginning early in life. Thus, children from marginalized backgrounds with lower educational and health opportunities have a lower social advantage in adulthood [36]. Similarly, adverse SE factors affect the development and progression of cardiovascular risk factors such as hypertension, obesity, and diabetes [20]. Lower SE class is also associated with increased substance abuse, which promotes CVD [24]. Figure 1 shows the interplay of SE and community factors affecting cardiovascular health.

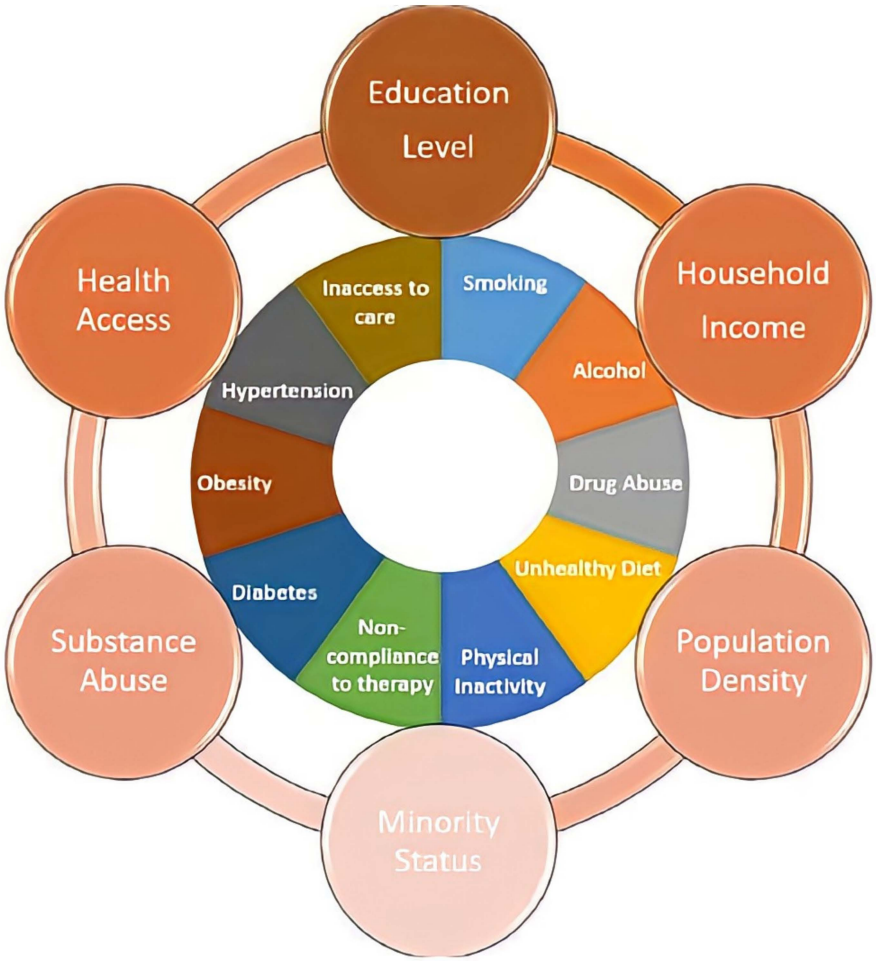

Figure 1. Socio-economic and community factors affecting cardiovascular risk factors and CVDs.

3. Socio-Economic and Community Factors Affecting COVID-19

Income, education, and occupation were associated with COVID-19 incidence and mortality among the SE factors investigated as shown in Table 1 [37–51]. First, data from the top 50 countries in COVID-19 cases showed reduced income disparities among people in a country correlated with reduced mortality (relative risk = 0.88; 95% confidence interval: 0.83–0.93) [38]. Individuals with lower income are more likely to experience overcrowded housing conditions with a heightened risk of infectivity. These individuals may be disadvantaged concerning being able to afford preventative therapy and treatment. Second, county-level data from the United States showed that the percentage of adults without a high school degree was the strongest SE determinant of COVID-19 incidence and mortality [42]. A lower level of education has been correlated with poor health behaviors such as smoking and an unhealthy diet, which may lead to increased infection rates and severity of COVID-19 [49]. Third, lockdown data from Columbia and other countries have shown lower restriction in movement or complete isolation in areas with lower levels of income and education, which has largely been attributed to the inability to perform essential and lower-income jobs remotely [47,52].

Table 1. Socio-economic factors and COVID-19.

Authors (Year)	SE Factor	Findings
[37]	Income	Lockdown data from Italy showed that lockdown was more effective in municipalities with higher fiscal capacity.
[38]	Income	Data from the 50 countries leading in COVID-19 cases showed reduced income dispersion correlated with reduced mortality.
[39]	Income and Population density	Mobility data from the United States showed that social distancing is less effective in counties with higher poverty levels and higher amounts of essential workers.
[40]	Population density	A retrospective cohort study in Michigan found that increased population density was associated with testing positive for COVID-19.
[41]	Population density	A zip code-level study from 5 major metropolitan areas showed that persons per household increased the proportion of positive COVID-19 cases by 1.83%.
[42]	Education	As of May 2020, in the US, the SE determinants of health with the strongest association to COVID-19 incidence and mortality per 100,000 persons was the percentage of adults without a high school degree.
[43]	Population density and Income	Data from New York at the start of the pandemic showed: -An increase of 10,000 people per km^2 was associated with a 2.4% increase in COVID-19 positivity rate. -A USD 10,000 median household income decrease was associated with a 1.6% increase in the COVID-19 positivity rate.
[44]	Income and Education	Surveys across the USA, Canada, and the UK showed that: -Individuals with lower income and lower educational attainment were more likely to have misperceptions about COVID-19. -A lower-income level was correlated with a greater perception of personal risk from COVID-19 across all three countries.
[45]	Population density and Education	A retrospective analysis at Massachusetts General Hospital found that increased population density and lower education were associated with a higher likelihood of infection.
[46]	Income	A cross-sectional analysis of the first 200 days of the COVID-19 pandemic in the US found that a 1% increase in a county's income inequality was associated with an adjusted relative risk of 1.020 for COVID-19 incidence and 1.030 for COVID-19 mortality.
[47]	Income	Lockdown data from Columbia showed areas with higher poverty had a lesser decline in mobility than areas with higher SE status.
[48]	Income, Employment, Education, and Race	A cross-sectional study in the US found various social factors, including SE status comprising unemployment rate, per capita income, and racial/ ethnic minority status, was associated with COVID-19 incidence and mortality.

Table 1. *Cont.*

Authors (Year)	SE Factor	Findings
[49]	Income, Education, Population density, Race and Minorities	19 out of 28 studies in a systematic review showed that: -Individuals with low SE status, including poverty, lower education, and household overcrowding, were at higher risk of infection, death, and confirmed diagnosis of COVID-19. -Racial and ethnic minorities are at increased risk of infection, having positive test results, and hospital admission from COVID-19.
[50]	Income, Education, and Population density	A retrospective analysis mapping COVID-19 incidence and mortality in Chile found: -Areas with lower income, education, and health factors were less compliant with stay-at-home orders. -An overall strong association between low SE status and COVID-19 mortality. -Lower education and household crowding were associated with an increased likelihood of hospitalization.
[51]	Education and Population density	Lower level of education and number of people living in a household were positively associated with an increased likelihood of hospitalization due to COVID-19 infection.

4. Socio-Economic and Community Factors Affecting Cardiovascular Disease, Cancer, and Cardio-Oncology

Cancer patients, CVD patients, and cancer patients with CVD are more vulnerable to developing complicated and fatal COVID-19 infection [53–55]. In particular, elderly (>65 years old), cancer patients, those with active hematologic or lung malignancies, or clonal hematopoiesis, and recent recipients of immune checkpoint inhibitor therapy are more susceptible to COVID-19 [56–58]. The COVID-19 outbreak particularly impacted cancer care, with many patients experiencing delays in diagnosis and management. For instance, the national cancer screening programs in the United Kingdom were suspended because of COVID-19 [59,60]. Curative cancer surgeries were also subject to change, delays, or cancellation due to safety concerns or resource constraints [59,61]. Fatal outcomes of COVID-19 infection have been strongly associated with CVD, diabetes, and hypertension [62]. Both direct and indirect cardiovascular complications related to COVID-19 have been reported in the literature, including acute myocardial injury, myocarditis, pericarditis, arrhythmias, venous thromboembolism, metabolic syndrome, and Kawasaki disease, likely mediated by many biologic mechanisms [62–65].

SE status as a social determinant of health has been at the forefront during the pandemic, as several studies have shown the effect of poor SE status on those afflicted by COVID-19. The same factors that lead to worse outcomes due to COVID-19 contribute to health disparities related to cancer and CVD. The intersection of these disparities within cardio-oncology requires examination, given the already present risk of health inequities in the growing number of those who have cancer and CVD. Several studies suggest that poor SE status is associated with excess risk factors, excess morbidity, and mortality from CVD (Table 2), cancer (Table 3), and cardio-oncology (Table 4) [3–26,66–97]. Increased population density, unemployment, illiteracy, lower income, and poor neighborhoods have been associated with adverse cardiovascular outcomes in general and specifically in cancer patients [3–10,14–17,19,22,23,25,26,85,90,92,96,97]. These factors likely play a major role in the increased incidence of cardiac adverse events in African Americans compared to the White population [6,11–13,18,20,21].

Table 2. Socio-economic factors and CVD.

Authors (Year)	SE Factor	Findings
[3]	Population density	Population morphology characteristics, especially an increase in the number of persons per housing unit, are positively associated with mortality due to CVD.
[4]	Education	SE status measures were closely associated with CVD risk factors (cigarette smoking, systolic and diastolic blood pressure, and total and high-density lipoprotein cholesterol) and with lower levels of education.
[5]	Occupation and Education	-In all countries, mortality from CVD is higher among persons with a lower occupational class or lower educational level. -Inequalities in CVD mortality are associated with disparities in certain risk factors, especially cigarette smoking and excessive alcohol consumption.
[6]	Neighborhood, Income, Education, Race, and Occupation	-Residents of disadvantaged neighborhoods had a higher risk of coronary heart disease than residents of advantaged neighborhoods, even after controlling for personal income, education, and occupation. -Hazard ratios for coronary heart disease among low-income persons living in the most disadvantaged neighborhoods, compared with high-income persons in the most advantaged neighborhoods, were 3.1 among Whites and 2.5 among Blacks, which remained unchanged after adjusting for established risk factors for coronary heart disease.
[7]	Race, Education, and Income	In Multi-Ethnic Study of Atherosclerosis with 6716 participants: -The US to foreign-born prevalence ratio for the carotid plaque was 1.20 in Whites, 1.91 in Chinese, 1.62 in Blacks, and 1.23 in Hispanics. -Greater carotid plaque prevalence was present in Whites, Blacks, and Hispanics with a greater number of generations with US residence. -Greater carotid plaque burden is present in Whites with less education and among Blacks with lower incomes.
[8]	Education	A higher risk of acute myocardial infarction was present in individuals with a lower educational level.
[9]	Income	Even after adjusting for smoking and alcohol consumption, an increased risk of nonfatal myocardial infarction and sudden cardiac death was found in the low-income cohorts.
[10]	Income	In a study of >15,000 patients in the Netherlands admitted for acute myocardial infarction or coronary heart disease, individuals in the lower quintiles of income had significantly higher 28-day and 1-year CVD-related mortality rates.
[11]	Race	Lack of access to quality care along with Black race compared to White race was associated with increased heart failure and post-acute myocardial ischemia hospital readmission rates in the United States.

Table 2. *Cont.*

Authors (Year)	SE Factor	Findings
[12]	Race	The trend of CVD between 1997 and 2008 in 4 communities in the US: -Average annual rate of incident myocardial infarction decreased non-uniformly across races (4.3% among White men vs. 1.5% among Black men) -Age-adjusted 28-day case fatality after hospitalized acute myocardial infarction declined non-uniformly across races (3.0%/y among White women vs. 2.6%/y among Black women)
[13]	Race	-African Americans had a higher prevalence of evaluated cardiovascular risk factors than Caucasians after controlling for obesity, tobacco use, and physical fitness. -Caucasians had a greater likelihood of no risk factors, while African Americans were more likely to have all three risk factors.
[14]	Income	-5.65% of the low-income patients received excellent quality of cardiac care compared to 11.48% of patients not in the low-income group. -The mortality rate of low-income patients (12.10%) was higher than patients not in the low-income group (5.25%). -Patterns of quality of care partially mediated the relationship between patient income level and coronary artery bypass grafting mortality.
[15]	Employment	Unemployment is associated with a high cardiovascular event rate and increased all-cause mortality in middle-aged socially privileged individuals.
[16]	Income and Education	Low income remains associated with a higher risk of coronary heart disease for younger individuals, regardless of education.
[17]	Education and Income	In a study with 15,350 adults, higher education and income level were associated with a higher proportion of meeting five or more ideal cardiovascular health metrics.
[18]	Race and Neighborhood	Among African American women, each standard deviation increase in neighborhood disadvantage was associated with a 25% increased risk of CVD after covariate adjustment (hazard ratio = 1.25).
[19]	Income	CVD prevalence (stroke, ischemic heart disease, and other CVD that led to hospitalization) was lower in high- and middle-income areas than in low-income areas (7.46%, 7.42%, and 8.36%, respectively).
[20]	Race	The higher prevalence of traditional CVD risk factors (e.g., hypertension, diabetes mellitus, obesity, and atherosclerosis) was associated with the relatively earlier onset of CVDs among African Americans.
[21]	Race	-Caucasians had higher odds of care by a cardiologist than African Americans (adjusted odds ratio: 1.42).
[22]	Income and Neighborhood	-An average increase in cardiovascular health score of 0.31 points is associated with each 1-category increase in individual income. -Each 1-category increase in neighborhood SE score was associated with a 0.19-point increase in cardiovascular health score.

Table 2. *Cont.*

Authors (Year)	SE Factor	Findings
[23]	Income	Low income was associated with high cardiovascular mortality (HR 1.31) and cardiovascular events (HR 1.07) in patients with hypertension.
[24]	Substance use disorder	People with substance use disorder are more likely to have prevalent CVD and develop incident CVD than people without substance abuse.
[25]	Income, Occupation, Education, and Health insurance	In two nationwide cohort studies in US and UK adults, low SE status had higher risks of mortality and CVD, and overall lifestyle only explained 3.0% to 12.3% of the excess risks.
[26]	Income and Education	Higher SE status was associated with the better achievement of most risk factor targets, participation in programs aimed at lifestyle change, and evidence-based drug therapies after myocardial ischemia.

Table 3. Socio-economic factors and cancer.

Authors (Year)	SE Factor	Findings
[66]	Race	-Compared with Whites, Blacks had an overall excess risk of death (HR 1.16). -After correction for deaths due to other causes, the cancer-specific hazard ratio was 1.07. -Of the 14 cancers studied, Blacks were at a significantly higher risk of cancer-specific death related to cancer of the breast, uterus, or bladder.
[67]	Income	Affluent women were less likely to present with invasive ductal tumors (70.8% vs. 85.9%), tumors of higher grade (36% vs. 44.7%), and estrogen receptor-negative tumors (22.4% vs. 33.3%).
[68]	Employment, car, and home ownership and Population density	-Townsend index incorporating four variables, including unemployment, non-car ownership, non-home ownership, and household overcrowding, was used to calculate deprivation level. -Breast cancer is rising in women of lower SE status in Scotland, and the deprived–affluent gap remains. -Trends in late age at first pregnancy, the prevalence of obesity, and screening uptake do not fully explain the observed trends.
[69]	Education	A higher risk of malignant disease, particularly smoking-related cancers, was found among the lowest educational attainment. Only some of the educational attainment could be related to smoking.
[70]	Income	Index of Multiple Deprivation 2004 is a tool composed of different variables of SE status. In this study, the postcode of residence-related income domain alone of the Index of Multiple Deprivation 2004 was used to calculate the level of deprivation.
[71]	Education, Employment, and Income	The cancer incidence was highest for the most deprived patients, especially for lung and cervical cancer. Overall, increased risk of lung cancer incidence in people with low education (61%), low occupational SE status (48%), and low income (37%).

Table 3. *Cont.*

Authors (Year)	SE Factor	Findings
[72]	Education, Employment, Poverty, and Income	-Low SE status groups exhibited a higher incidence of colorectal cancer than high SE status groups in the US and Canada. -Patients with a low SE status received (neo)adjuvant therapy less often, had worse survival rates, and generally exhibited the highest mortality rates up to 1.6 risk ratio for colon cancer and up to 3.1 risk ratio for rectal cancer.
[73]	Factor-based deprivation index	-Factor-based deprivation index that consisted of 11 census-based social indicators, which may be broadly represented by educational opportunities, labor force skills, economic and housing conditions in a given area, was used to measure deprivation. -More disadvantaged groups and rural areas residents had higher cancer mortality compared to those residing in more affluent and urban areas, especially for lung, colorectal, prostate, and cervical cancers. -SE inequalities were present in both Whites and Blacks. -Blacks experienced higher mortality from each cancer than Whites within each deprivation group.
[74]	Urban-rural area and Income	-The incidence of lung cancer was higher in urban deprived areas than in affluent rural areas in England. -Adjusting for SE deprivation, little difference was seen between the incidence and survival of lung cancer in urban and rural areas.
[75]	Income	Graded inverse associations between income and mortality were found for most, but not all, specific causes of death. The major contributors to income differentials in total mortality included lung and liver cancer in both men and women
[76]	Education	-Large educational inequalities were observed in cancer mortality, mainly for cancer of the cervix, stomach, and lung. -Mortality from cervical cancer declined more rapidly in groups with lower educational attainment.
[77]	Race, Neighborhood, and Ethnicity	Mortality was higher among Blacks than Whites. Cancer patient survival was significantly lower in more deprived neighborhoods and among most ethnic minority groups.
[78]	Income	Lung cancer was the most significant driver of cancer inequality trends, followed by colorectal cancer in men and breast cancer in women.
[79]	Occupation type	SE status remained a significant risk factor for lung cancer after adjustment for smoking behavior.
[80]	Income	The absolute difference between the cancer rates in the highest- and lowest-incidence region, per 100,000 people, has widened from 39 to 86 for females and from 94 to 116 for males.

Table 3. *Cont.*

Authors (Year)	SE Factor	Findings
[81]	Area Deprivation Index	-In this study, neighborhood SE status was measured using the area deprivation index, a validated, comprehensive tool to measure SE status. Individual SES was evaluated by Medicare–Medicaid dual eligibility, a reliable indicator for patient-level low income. -Deprivation in the neighborhood was associated with worse survival among patients with non-metastatic cancers, even after accounting for individual SE factors.
[82]	Area Deprivation Index	-Zip codes linked Area Deprivation Index composed of 17 diverse indicators of SE status was used to evaluate the level of deprivation in the study. -Compared to the most affluent participants, participants from the highest SE deprivation area had worse overall progression-free and cancer-specific survival.
[83]	Income and Neighborhood	SE status, level of literacy, and area of residence were the main contributors to the observed inequality in screening mammography among Iranian women of Kurdish descent.

Table 4. Socio-economic factors and cardio-oncology.

Authors (Year)	SE Factor	Findings
[84]	Race	Higher incidence of doxorubicin-related cardiotoxicity for breast cancer patients among Blacks compared to non-Black patients (7/100 compared to 10/399).
[85]	Income and Education	In a large cohort, the relative risk of five compared with zero lifestyle risk factors prevalent in low SE status areas was: -4.31 for all-cause mortality. -3.36 (95% CI 2.45 to 4.34) for cancer mortality. -8.17 (95% CI 4.96 to 13.47) for cardiovascular mortality.
[86]	Race	-Hypertension was an independent predictor of the survival disparity between Black and White survivors of invasive breast cancer. -In a follow-up of 9 years, African Americans had a higher overall crude mortality of 39.7% than Whites of 33.3%.
[87]	Race	A higher incidence of cardiac events was noted among Black patients with diabetes, hypertension, or CVD who were treated with trastuzumab compared to White patients with the same conditions: 3/15 (20%) vs. 4/48 (8.3%), respectively.
[88]	Race	African American patients with breast cancer had a higher risk of developing decreased left ventricle ejection fraction while on trastuzumab therapy compared to other races.

Table 4. *Cont.*

Authors (Year)	SE Factor	Findings
[89]	Race	There is a higher risk of cardiovascular death in Black breast cancer survivors than White breast cancer survivors with ductal carcinoma in situ at ages 40–49, 50–59, and 60–69 with a hazard ratio of 14.99, 6.43, and 2.26, respectively. There was no significant difference in hazard of cardiovascular death between Black and White patients 70 years and older.
[90]	Education	-Analyzing >2 million person-years of follow-up in 24 studies, 11,065 deaths (3655 from CVD and 4313 from cancer) and 1809 CVD nonfatal events were recorded. -Hazard ratios for primary relative to tertiary education were 1.81 for all-cause mortality, 2.47 for CVD mortality, 1.66 for cancer mortality, and 2.09 for all CVD.
[91]	Ethnicity	The mortality rates for cancers varied by national origin. Filipino, Asian Indian and Pakistani, and Pacific Islander groups had a risk of cardiovascular mortality similar to White women. Hawaiian women had a higher risk of cardiovascular mortality (hazard ratio, 1.43; 95% confidence interval, 1.17–1.75) compared with White women. US-born Asian and Pacific Islander breast cancer survivors had a higher risk of cardiovascular mortality (hazard ratio 1.29; 95% confidence interval, 1.08–1.54) compared with immigrant survivors of breast cancer.
[92]	Geography, Income, and Health care access	-The number of Childhood Cancer Survivor Study centers within the geographic area was associated with greater odds of receiving risk-based survivor-focused medical care. -Higher-income areas had higher echocardiogram screening among survivors at risk of cardiomyopathy (for every USD 10,000 increase in average income, there was a 12% increase in odds of echocardiogram screening). -A significant positive association was identified between the number of physicians and surgeons in the county of residence and the likelihood of an echocardiogram being recommended for residents.
[93]	Race	-The 1-year cardiotoxicity incidence was 12% overall, 24% in Black women, and 7% in White women. -Black patients had a higher likelihood of not completing therapy than White patients.
[94]	Race	Black survivors of breast cancer had an increased 20-year cumulative mortality rate from CVD, with a more pronounced effect in younger patients.
[95]	Race	Treatment with hormone therapy or chemotherapy was suggested to contribute to the CVD mortality disparities between Black and White survivors of breast cancer, although the results in this study did not reach statistical significance.

Table 4. *Cont.*

Authors (Year)	SE Factor	Findings
[96]	Education, Employment, and Population density	In 109,246 Finnish adults, a cascade of inter-related health issues with a hazard ratio>5 was identified: ischemic heart disease, cerebral infarction, lung cancer, and other diseases in lower SE status patients.
[97]	Income	Referral patterns of patients with hypertension and breast cancer receiving cardio-toxic chemotherapy agents to cardio-oncology or cardiology clinics were higher for residents of higher-income quartile ZIP codes.

Multiple studies have reported increased cancer treatment-related cardiotoxicity in Blacks compared to other races [84,86–89,93–95]. There is a paucity of data reporting the impact of the SE factors with cardio-oncology compared to CVD or cancer alone. However, as demonstrated in the Tables, SE and community factors contribute significantly to incidence, prevalence, progression, and fatal outcomes in cancer, CVD, and cardio-oncology.

5. Measures to Address Socio-Economic and Community Disparities

Disadvantaged social status has left many Americans at greater risk for poor health and health care outcomes from the COVID-19 pandemic. Ain addition, cancer, CVD, and cancer patients are more vulnerable to developing complicated and fatal COVID-19 infection [53–55]. The complexity of the health disparities requires multisectoral action to tackle the problem [98]. Improving education is one of the most crucial factors in increasing employment and reducing the risk of social exclusion. Intervention at different community levels has been proposed, encompassing schools, workplaces, healthcare facilities, and religious organizations [98]. Using social media platforms can help widen messages to improve health behavior. For example, the Princess Margaret Cancer Center in Canada released education materials and a website for online cancer classes for patients and families [99].

Another essential measure includes efforts to reduce wealth inequality, which will help in improving economic mobility, physical and mental health, and life quality for the underprivileged. Financial stability improves health directly and indirectly by helping individuals and families move to safer neighborhoods, invest in their children's future success, and save for retirement [100,101]. Fiscal and economic interventions targeting lifestyle include tax reforms to increase alcohol and tobacco unit prices. Addressing dietary inequality is also essential. Fruits and vegetables must be made affordable to lower SE groups. Labeling products with high fat/sugar content and other unhealthy ingredients might help customers make informed health decisions [102,103]. A study showed that a 1-year public health campaign in the United States would help improve fruit and vegetable intake by 7%, which would prevent around 600 CVD deaths [102]. The implementation of policies that ensure a living wage income will help improve wealth inequalities and fight food insecurity. The social protection of people at risk of poverty and inability to work must be assured through a system of income support and benefits [104]. Downstream interventions include outdoor walking, running, and cycling to help maintain social distancing while encouraging physical activity. Smoking cessation services demonstrated the most remarkable measure to reduce cardiovascular risk among all SE status groups [102]. To support these downstream interventions, upstream interventions with rigid policies and accessible health care facilities are needed for lower SE groups [102]. Addressing racial or ethnic disparities requires dismantling structural racism and including more people of color in the healthcare workspace, clinical trial, and regulatory bodies [105]. Unique challenges of minority groups, including language barriers or limited geographic representation in research and clinical practices, must be addressed. Burgeoning racial or ethnic disparities in cardio-oncology stem from long-standing differences in health care more broadly. Interventions designed to mitigate these disparities must consider social and structural

determinants of health and use innovative approaches to increase preventive and specialty care access [106].

The increased risk of COVID-19 in cardio-oncology patients requires creative measures to minimize patient exposure while providing essential medical care. Transitioning to telemedicine in outpatient settings and considering decreasing the frequency of outpatient cardiotoxicity surveillance testing for asymptomatic/low-risk patients was adopted at the pandemic's start [107]. Precaution against COVID-19 recommended by the Centers for Disease Control and Prevention, including free mask and sanitizer supply, awareness to avoid public gatherings, easy access to vaccinations, early testing, and affordable hospital access must be promoted to low SE groups. Even with the ongoing pandemic at hand, as much as possible, institutional policy should prioritize timely and life-saving cancer screening interventions, and cancer surgeries should not be considered elective. Patients with cancer on active myelosuppressive therapy, those undergoing a hematopoietic stem cell transplant, or with a hematologic malignancy associated with inherent immunodeficiency may not be able to mount an adequate COVID-19 antibody response, despite obtaining the vaccine. Increased awareness and precaution toward this vulnerable population are needed. Equal access to and awareness about the latest treatments such as the recently Food and Drug Administration-approved experimental emergency use authorization drug Evusheld (tixagevimab and cilgavimab) in this immunocompromised population for pre-exposure prophylaxis is essential [108].

With the rampant use of social media across various SE strata, the ultimate responsibility of avoiding the spread of medical misinformation falls on the shoulders of health care workers and the community. Responsible social media usage has become highly relevant in today's times. The problem of inequalities in health is deep-rooted and tackling it will need a sustained and systematic effort. We suggest interventions addressing macro environmental factors (income and education), the physical and social environment, adverse health behaviors, and access to health care (Figure 2). Action is required at the international, national, regional, and individual levels.

EDUCATION

- Educational policies for schools
- Health awareness campaigns
- Workplace health education
- COVID 19 precaution awareness
- Advocacy against spreading misinformation

ECONOMIC STABILITY

- Economic reforms and policies
- Subsidized food prices
- Enriched food availability
- Availability of masks and sanitizers
- Employers abiding by the FFCRA (Families First Coronavirus Response Act)

HEALTH CARE SYSTEM

- Health care policies
- Accessible health centers
- Subsidized insurance by employees
- Telemedicine
- Timely curative cancer surgeries
- Access to COVID-19 testing and vaccination
- Access to latest FDA approved drugs

MEASURES TO ADDRESS SOCIOECONOMIC AND COMMUNITY DISPARITIES IN CARDIO-ONCOLOGY DURING COVID-19

SCREENING & MITIGATION

- Availability of cardiac risk factor mitigation strategies
- Timely access to cancer screening modalities

PHYSICAL ENVIRONMENT

- Improved access to green outdoors
- Quality built housing
- Hygienic surroundings
- Reduce air pollutants

SOCIAL SUPPORT

- Social groups and networking
- Non-government organizations
- Responsible use of social media to spread information and prevent circulation of misinformation.

RACISM AND SEXUAL ORIENTATION

- Bias mitigation
- Health care staff diversity
- Representation in trials
- Rigid anti-discrimination policies
- Diversity inclusion groups

CULTURAL & LINGUISTIC BARRIERS

- Access to interpreter services
- Training of staff towards cultural sensitivity
- Travel COVID-19 guideline implementation

SUBSTANCE ABUSE

- Education & Motivational interviewing
- Access to deaddiction clinics
- Identification of high-risk individuals with regular follow-ups

MENTAL HEALTH & STIGMA

- Online support groups
- Availability of mental health providers
- Online suicide prevention helpline

RESEARCH & PHARMACEUTICALS

- Affordable drugs & screening tests
- Identification of "At risk populations"
- Enhanced enrollment of racial minorities in clinical trials

Figure 2. Measures to address socio-economic and community disparities in cardiology, oncology, and cardio-oncology during COVID-19.

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