

The arts for disease prevention and health promotion: a systematic review

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Jill Sonke¹✉, Michael Koon Boon Tan², Jennifer Baxley Lee¹, Virginia Pesata¹, Seher Akram¹, Tasha Golden¹, Jane Morgan-Daniel³, Sanmi Oduntan⁴, Sharifa Abdulla⁵, Daisy Fancourt⁶, Michael Pratt⁷, J. Jaime Miranda⁸, Courtney Pyche³, Kremlin Wickramasinghe⁹, Nils Fietje¹⁰ & Nisha Sajani¹¹

Differences in risk factor exposure and access to prevention resources have led to unequal health outcomes for noncommunicable diseases (NCDs) globally. Recent studies elucidate the health benefits of arts participation, but no systematic reviews have focused on NCD prevention and health promotion. Here we share results of a mixed-methods systematic review that included 95 studies of arts programs, practices and activities, addressing NCD risk factors across 27 countries. We found that most reported outcomes were related to physical inactivity, unhealthy diets, mental health, and systemic, structural and social drivers of health. Our findings suggest that the arts may support NCDs prevention and health promotion by generating cultural relevance, providing opportunities for increased physical activity and social connectedness and by helping to identify and address systemic, structural and social forces contributing to health disparities and inequities.

Noncommunicable diseases (NCDs) are linked to 74% of deaths globally¹, with a disproportionate impact on low-income and middle-income nations and marginalized groups. They also affect longevity and quality of life for millions around the globe^{2,3} and substantially impact the national and global economies by impairing productivity, increasing healthcare expenditures and straining healthcare services^{3,4}. Moreover, unaddressed NCD risk factors—such as individual behaviors, air pollution and structural and systemic inequalities—increase the prevalence and burdens of NCDs, placing pressure on healthcare systems⁵. Disparities in exposure to risk factors and access to preventive resources and services have led to inequitable health outcomes and quality of life both within and across countries⁶. These health inequities, combined with ongoing challenges related to NCDs worldwide, create a pressing need for enhanced research, and broader

strategies to address risk factors, promote resource equity and improve NCD outcomes^{7–10}.

Recent studies have elucidated health benefits of arts participation and ways that the arts can support health equity, such as deepening awareness of inequities, amplifying marginalized voices and facilitating collective action and strategies for addressing inequities^{11–20}. Recent research findings suggest that the arts can be understood as a public health resource and arts participation as a health behavior^{21–24}. For example, numerous studies have examined the capacity of the arts to enhance quality of life²⁵; complement therapeutic, rehabilitative and preventive efforts^{26–29}; and promote resilience and well-being in communities^{30–32}, among other health outcomes. However, no systematic reviews have been published on how the arts can contribute to the prevention of NCDs in communities. In response to the need to

¹Center for Arts in Medicine, University of Florida, Gainesville, FL, USA. ²Nanyang Academy of Fine Arts, University of the Arts Singapore, Singapore, Singapore. ³Health Science Libraries, University of Florida, Gainesville, FL, USA. ⁴College of Medicine, University of Lagos, Lagos, Nigeria.

⁵University of Malawi, Malawi, and University of Glasgow, Glasgow, Scotland. ⁶Institute of Epidemiology & Health Care, University College London, London, United Kingdom. ⁷Herbert Wertheim School of Public Health & Human Longevity Science, University of California, San Diego, San Diego, CA, USA. ⁸Sydney School of Public Health, University of Sydney, Sydney, Australia. ⁹World Health Organization, Geneva, Switzerland. ¹⁰World Health Organization Regional Office for Europe; Jameel Arts & Health Lab, Copenhagen, Denmark. ¹¹Department of Music and Performing Arts, New York University; Jameel Arts & Health Lab, New York City, NY, USA. ✉e-mail: jsonke@ufl.edu

PRISMA 2020 flow diagram for new systematic reviews that included searches of databases, registers & other sources

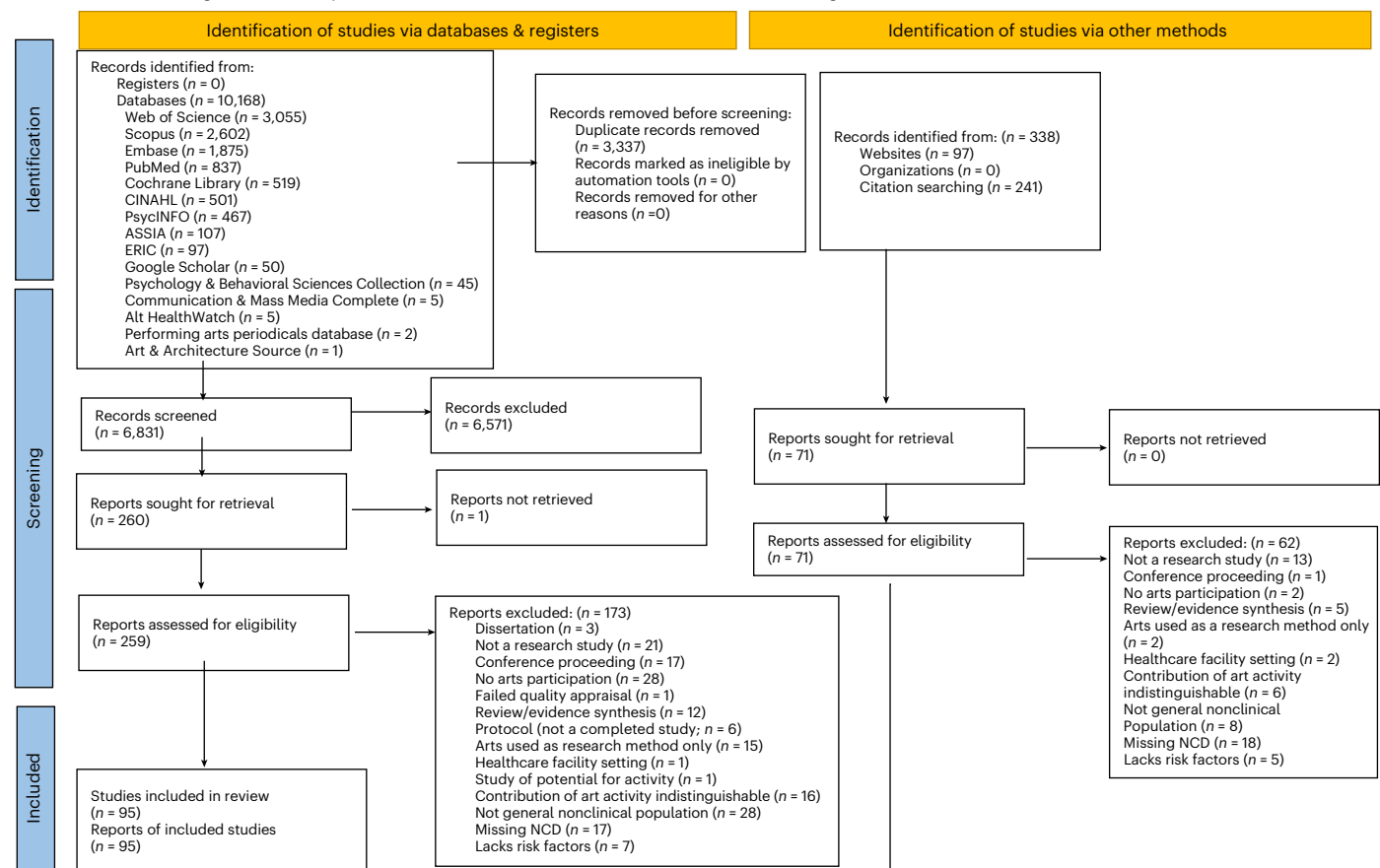


Fig. 1 | Systematic review flow diagram. PRISMA flow diagram for a systematic review of evidence for the roles of the arts in non-communicable disease prevention and health promotion.

expand NCD prevention strategies and explore potential contributions of the arts, this review (PROSPERO 2024–CRD42024506862) used a broad definition of arts participation³³, and asked the following: what evidence exists regarding the use of the arts for health promotion and prevention of NCDs in the general nonclinical population worldwide? It also engaged the following three subquestions:

1. Where are the arts being used globally for NCD prevention and health promotion?
2. What enablers and barriers, including structural and systemic, have been reported regarding the incorporation of the arts in NCD prevention and health promotion efforts?
3. How have strategies for incorporating the arts addressed health equity issues in global NCD prevention and health promotion efforts?

Results

Quantitative results

A total of 10,168 studies were identified through the database searches, of which 86 met inclusion criteria (Extended Data Table 1). Nine were then identified through hand searching or snowballing, resulting in a final sample of 95 studies (Fig. 1).

Where are the arts being used globally for NCD prevention and health promotion?

Study characteristics. The 95 studies were published between 1992 and 2024, with 71 published after 2010. They reported on programs and interventions in 27 countries. Study designs were highly

heterogeneous. Sixty-seven studies, including 16 randomized controlled trials, used quantitative analysis only. There were 26 quasi-experimental and nonexperimental studies. There were 16 mixed methods and 12 qualitative studies (Extended Data Table 2).

Study populations. A total of 233,718 research participants from ten racial/ethnic groups and a range of ages were represented in the 95 studies (Table 1). Global majority and/or regionally minoritized/marginalized groups were the focus of study in most articles^{34,35}. Thirty-four articles did not report race or ethnicity, and numerous included more than one group.

Twenty-seven countries were represented across the data, with 58 studies of populations in the United States, 10 in the United Kingdom and 9 in Australia. Notably, given that these nations have a high proportion of immigrants, country cannot be equated with culture and it cannot be assumed that these groups can represent their country of origin³⁶. Canada was represented in three studies and China, India, Indonesia, the Philippines and South Africa were represented in two articles each, while the remaining 18 countries (Argentina, Austria, Barbados, Belgium, Brazil, Israel, Japan, Mexico, Norway, Peru, Poland, Portugal, Russia, Slovak Republic, South Korea, Spain, Sri Lanka and Switzerland) were each represented in a single article. Together, these 27 countries represent more than 59% of the world's population. Of the countries represented, all but one (India) have a high to very high Human Development Index³⁷. Many ($n = 55$) included children, with 49 involving school-age children (6–17 years) and 6 preschool (0–5 years). A total of 30 studies involved adults (18–49 years), while 18 involved older adults (50+ years).

Table 1 | Demographic characteristics of groups studied

Characteristics	Number of studies
Race, ethnicity, indigeneity	
Not reported	34
African American/Black	34
Hispanic	29
White	19
Asian	15
American Indian/Alaska Native	11
Mixed race	8
Pacific Islander	4
African	2
Aboriginal First Nation	1
Middle Eastern	1
Indigenous	12
Underserved, marginalized or regionally minoritized groups	
Age groups—children (0–17 years)	55
Age groups—older adults (50 years and older)	18
Low economic status	41
Minority (as reported, in the country of study)	40
Female (studies with females only)	8
Language barrier	8
Rural	6
Homeless	4
Low education level 3	3
Immigrants (studies with immigrant only)	2

Note: several studies reported multiple populations.

Types of Interventions. Forty-nine articles reported on health communication programs (for example, radio novellas and theater productions) designed to increase knowledge and awareness or reduce stigma related to NCDs or their risk factors. Forty-six articles reported on studies of active interventions (for example, dance classes and gardening), wherein people participated actively in arts-based activities related to NCDs or their risk factors. Both intervention types were generally intended to influence health behaviors.

Most interventions took place in schools ($n = 45$) and community ($n = 46$) settings, including arts/cultural and faith-based settings; four were delivered only through electronic, broadcast or print media. As shown in Extended Data Table 3, a broad range of modes and forms of arts engagement were included in the studies.

Outcomes studied. The articles reported on programs designed to address a range of outcomes across NCDs and risk factors, including physical inactivity ($n = 22$), unhealthy diets ($n = 38$), systemic, structural and social drivers of health ($n = 114$) and mental well-being ($n = 33$). No articles addressing air pollution were found. Specific outcomes studied are presented in Table 2. Among the included articles, 22 reported anthropometric measurements; of those, body mass index (BMI) was most reported ($n = 9$). Further analyses of quantitative results were not feasible because of the heterogeneity of study designs and inconsistency in measurement between populations that included different languages, countries and cultures.

Intervention efficacy. Given heterogeneity in interventions, measures and reporting, a full analysis of intervention efficacy was not feasible. However, findings reported as ‘statistically significant’ in quantitative

studies were analyzed; most of which were related to fruit/vegetable intake, BMI and mental health (Supplementary Note 1). In addition, given the problematic nature of P values and reporting statistical significance and as a way of further viewing or considering potential usefulness of the arts, we categorized 75 studies that included quantitative measures (some tested multiple outcomes) as reporting desirable, neutral or undesirable findings³⁸. Seventy-one studies reported desirable outcomes, most commonly physical health metrics, dietary changes and knowledge; 21 studies reported neutral outcomes, mostly related to physical and mental health and 1 study reported undesirable quantitative outcomes (Supplementary Note 2).

Quality appraisal. While the quality assessment with diverse studies tool does not establish a cutoff score for high or low quality, most scores were in the higher 2 of 4 ratings in 12 of 13 appraisal categories (Extended Data Table 4). Across articles, we found that reporting was least comprehensive regarding the following two factors: evidence that stakeholders were considered in the research design or conduct, and appropriateness of sampling to address research aims. In addition, some studies that lacked rigor offered important descriptive information related to our research questions.

Qualitative results

The thematic synthesis³⁹ of qualitative findings from qualitative ($n = 12$) and mixed methods ($n = 16$) studies generated themes related to our secondary research questions. Consistent with quantitative results, qualitative studies reported themes reflecting desirable physical, behavioral, nutritional and mental health outcomes among participants. In addition, qualitative results provided more nuanced insights regarding program structures/strategies, responses and issues of health equity.

What enablers and barriers, including structural and systemic, have been reported globally regarding the incorporation of the arts in NCD prevention and health promotion efforts? The following three themes were identified: (1) importance of community collaboration, ownership and cocreation (cocreation refers to collaborative creative processes in which people come together to create works of art); (2) importance of cultural relevance and (3) issues of resources and sustainability. Table 3 presents the identified subthemes, enablers and barriers.

How have strategies for incorporating the arts addressed health equity issues in global NCD prevention and health promotion efforts? Table 4 presents four themes related to this question. Notably, arts-based interventions were often developed in response to recognized health disparities and inequities, such as higher prevalence of obesity or diabetes among particular groups. Many were motivated by the need to address social or structural drivers of health, such as historical/collective trauma, poverty, marginalization, lack of access to healthy food and displacement.

Integrated quantitative and qualitative findings

By integrating quantitative and qualitative findings^{40,41}, we synthesized key points that further address this review’s research questions. The findings highlight particular applications of the arts and how they address NCDs and their risk factors. Using a joint display^{42–44} (Extended Data Table 5), back-and-forth exchanges⁴¹ between the quantitative and qualitative data allowed for the identification of qualitative themes that support or elaborate upon quantitative findings, and vice versa.

Arts-based approaches are often engaged to serve global majority, regionally minoritized and/or marginalized groups. While 81% ($n = 77$) of articles reported on programs in the United States, the United Kingdom and Australia, 58% ($n = 55$) reported on programs for

Table 2 | All outcomes measured

Category	Subcategory	Outcome measured	Number of studies
Social drivers of NCDs, including systemic and structural drivers (n=114)	Systemic drivers (n=9)	Capitalism	1
		Zoning	1
		Built environment	2
		Government	1
		Healthcare system	1
		Media	1
		Industry/corporations	2
	Structural drivers (n=84)	Structural oppression	1
		Structural racism	2
		Structural sexism	1
		Poverty/low economic status	41
		Unemployment	1
		Lack of affordable housing	1
		Food deserts	4
		Food insecurity	6
		Lack of transportation	2
		Lack of access to healthcare	9
		Lack of access to health information/services	4
		Lack of access to healthy food options	3
		Lack of access to physical activity opportunities	2
		Discrimination	3
		Stigma	4
	Social drivers (n=21)	Cultural norms/preferences	3
		Gender bias	1
		Social isolation	3
		Mental health stigma	2
		Lack of social support	1
		Language barriers	2
		Low health literacy	2
		Historical trauma	2
		Social exclusion	2
		Alienation	2
Transitional stressors for new migrants	1		
Mental well-being (n=33)	Mental well-being	3	
	Psychological well-being	1	
	Depression/depressive symptoms	6	
	Mental health	5	
	Anxiety	3	
	Stress	2	
	Mental distress	2	
	Mental functioning	2	
	Cognitive function/functioning	2	
	Life satisfaction	3	
	Well-being	2	
	Quality of life	1	
	Mood	1	

Table 2 (continued) | All outcomes measured

Category	Subcategory	Outcome measured	Number of studies
Physiologic measures (n=22)		BMI	9
		Blood pressure/hypertension	3
		Heart rate	2
		Waist circumference	2
		Body fat	1
		Cardiovascular risk factors	1
		Aerobic capacity	1
		Timed mile run	1
		Lipid level	1
		Insulin level	1
Physical inactivity (n=22)		Physical activity	12
		Physical activity levels	3
		Screen time	3
		Television viewing	3
		Sedentary behavior	1
Unhealthy diets (n=38)		Fruit and vegetable intake	11
		Dietary intake	8
		Food-purchasing behavior	1
		Diet quality	1
		Food insecurity	1
		Knowledge	14
		Health literacy	1
		Public health literacy	1
Tobacco use (n=3)		Smoking behavior/cigarette smoking	3
Harmful use of alcohol (n=4)		Alcohol consumption	4
Other outcomes studied (n=29)		Substance use (not tobacco or alcohol)	2
		Cultural attendance/engagement	2
		Cultural identity	1
		Awareness	6
		Attitudes	5
		Intent/intention	5
		Perceived benefits	3
		Perception	2
		Self-efficacy	2
		Readiness to change	1

Note: several studies reported multiple outcomes measured.

minoritized, migrant, diasporic and marginalized groups in those locations. Qualitative findings elaborated that, among these groups, the arts were often used to enhance an intervention's reach, participation and outcomes by elevating affected voices/experiences, improving cultural relevance and honoring cultural practices^{45,46}.

The arts can be useful in improving the cultural relevance of NCD prevention programs. Culturally tailored imagery, narratives, characters and activities enhanced cultural relevance, and thereby receptivity of programs for specific groups (for example, Latina women and Indigenous youth). Considerations for culturally relevant media or platforms (for example, radio and music), and traditional or culture-specific

Table 3 | Themes related to enablers and barriers

Themes	Subthemes	Enablers	Barriers
Theme 2.1: The arts can enable—and often reflect—community collaboration, ownership and cocreation ^{45,46,48–50,59,61,68,84–86}	Subtheme 1 Community involvement in program design and implementation is necessary ^{77,86} Subtheme 2 Participatory arts practice and research methods (for example, community advisory boards and youth engagement) enable incorporation of local knowledge and expertise and increase relevance ^{46,49,56,59,87} Subtheme 3 There are sometimes disjunctions and gaps between intended and actual community collaboration ^{61,88}	Community involvement, ownership and decision-making in program content, design and implementation (Subtheme 1) Community participation that enables cultural relevance and stakeholder support (Subtheme 1) Cocreation and participatory processes inherent in many arts practices, which can strengthen agency (Subtheme 2) Participatory arts practice and research methods (for example, community advisory boards and youth engagement) that enable incorporation of local knowledge and expertise to increase relevance (Subtheme 2) Partnerships with community organizations (Subtheme 3) Interdisciplinary, cross-sectoral and interprofessional collaboration (Subtheme 3) Engagement of local leaders (Subtheme 3)	Time constraints for both implementers and participants (Subtheme 1) Geographic spread and lack of public transportation in rural areas (Subtheme 1) Difficulties in securing participation due to lack of trust (Subtheme 2) Challenges with local community politics (Subtheme 2) Lack of effort to engage community members in decision-making (Subtheme 3) Inadequate communication such as a need for increased or improved communication between collaborators (Subtheme 3)
Theme 2.2: The arts provide a useful frame for bringing cultural relevance to health promotion and prevention programs ^{45,46,49,50,59,61,85,89}	Subtheme 1 Culture is a vehicle for health promotion ^{45,48,85,89} Subtheme 2 Cultural identity and representation are critical to health promotion and should be defined and guided by community members ^{46,49,73}	Culturally tailored interventions (Subtheme 1) Use of culturally relevant art forms and media platforms (Subtheme 1) Incorporation of cultural values, norms and practices, including culturally specific communication strategies and platforms (Subtheme 2) Integration of cultural values, norms, elements, interests and practices (Subtheme 2)	Language barriers (Subtheme 1) Lack of trust in the researchers or the research process from community members (Subtheme 2) Lack of community engagement in program design (Subtheme 2)
Theme 2.3: Financial and structural resources are a challenge to arts-based interventions ^{68,73,77,90,91}	Subtheme 1 Resource allocation for arts-based interventions can be challenging ^{66,67} Subtheme 2 Lack of resources and stakeholder buy-in limit sustainability of arts-based interventions ^{84,92}	Funding from diverse sources (Subtheme 1) Local leadership/decision-maker support (Subtheme 2)	Limited staff resources and budgets (Subtheme 1) Challenges with reimbursement for services (Subtheme 1) Lack of sustainable funding (Subtheme 2) Lack of secure tenure for community spaces (Subtheme 2) Lack of long-term data on intervention effectiveness and sustainability (Subtheme 2)

practices (for example, dance and gardening) and norms (for example, foods and language) appear to enhance access, increase uptake of health information and encourage change^{47–50}. However, these benefits can be compromised by lack of trust when they are not designed or facilitated by members of a community or a group^{46,51}.

The arts can help identify and illuminate systemic, structural and social drivers of health. Systemic, structural and social drivers were the largest category of issues and outcomes addressed in the reviewed articles ($n = 84$). Quantitative and qualitative findings indicate the use of the arts to help identify and address these drivers^{52–57}, and highlight how the arts can, for example, elevate affected voices and increase visibility and awareness of effects of historical trauma. In this way, the arts can support efforts to mobilize communities toward structural change^{34,53,55,58}. Qualitative findings underscore the importance of collaborating with intended beneficiaries in intervention design; notably, quantitative findings and our quality appraisal suggest that many programs are failing to do so or to report this information.

The arts may be particularly useful in facilitating health communication and understanding. More than half of the articles in this review reported on arts-based health communication programs ($n = 49$). Both qualitative and quantitative data suggest that the arts

can be engaging, connective, inclusive and culturally relevant^{59,60}, and that through accessible artistic platforms and adaptive communication pathways (for example, metaphor and representation), health concepts and complex issues can become more enjoyable^{5,35,59,61} and understandable^{6,39,48,49}. Arts-based interventions can reduce stigma, enable dialog around difficult topics and challenge negative stereotypes^{6,7,10,24,62,63}. Conversely, they can also perpetuate negative stereotypes and stigmatization or bias toward certain behaviors and conditions⁶⁰.

The arts may have particular application in prevention of cardiovascular disease (CVD) and mental ill-health. Studies concerning CVD ($n = 54$) and diabetes ($n = 41$) were prevalent as were physical inactivity ($n = 22$) and unhealthy diets ($n = 21$) as risk factors. Qualitative findings highlight that arts interventions can promote physical activity, dietary improvements and nutritional awareness^{59,64}. In relation to mental well-being ($n = 33$), quantitative and qualitative findings alike indicate that arts participation supported social connectedness, self-expression and cultural identity, which have been identified as protective factors for mental ill-health^{57,59} and that public arts events increased awareness—and humanized experiences—of mental ill-health^{65,66}. Arts programs designed to facilitate self-expression and emotional engagement were identified as enhancing mental well-being^{50,64,67}.

Table 4 | How arts strategies address health equity?

Themes	Subthemes
Theme 3.1: Many arts programs were developed in recognition of, or helped to identify, health disparities and inequities ^{48,50,57,59,84}	Arts-based programs/interventions can be built in response to documented NCD-related health disparities and inequities, such as disproportionate prevalence of obesity, diabetes, CVDs, hypertension, etc., among specific populations. Arts-based programs/interventions can identify and illuminate disproportionate impacts of mental ill-health and behavioral issues among particular populations, as well as food deserts, limited access to healthy foods and barriers to mental health support in particular regions, such as low-income or rural areas.
Theme 3.2: Arts programs can be designed to address systemic, structural and social drivers of health ^{45,49,50,77,78}	Arts program/intervention design, implementation and measurement recognize and respond to systemic, structural and social drivers of health, such as the effects of historical and collective trauma, adverse childhood experiences, social exclusion, lack of transportation, lack of land tenure, etc. Arts programs/interventions can amplify the voices of those affected by marginalization, displacement, erasure, etc., enabling them to describe and address these experiences. Arts programs/interventions can promote community-based program participation as an opportunity for community improvement and mobilization.
Theme 3.3: Cultural relevance supports access in health promotion programs ^{45,46}	Culturally relevant media or platforms (for example, radio for Hispanic immigrants, hip hop for youth) can be used to support communication and engagement. Arts programs/interventions can enhance health communication by incorporating traditional or culturally specific practices, histories and narratives. Culturally relevant art forms can encourage and increase participation in health promotion programs. Arts programs/interventions can shift discourse and perceptions and can be particularly useful in enabling dialog around health issues, communicating complex health information and addressing difficult topics such as negative perceptions of NCDs.
Theme 3.4: The arts are multimodal and can produce multiple, and multidimensional, outcomes ^{50,57,60,66,93}	Arts-based interventions designed to increase physical activity can also increase emotional engagement, enjoyability and provocation, cognitive, creative and sensory engagement, social connectedness, 'shared' experiences, and/or skill and knowledge sharing. Arts-based programs/interventions can yield social connectedness from multidimensional engagement and the cocreation of experiences, products and spaces. Social connectedness may serve as a protective factor and can promote participation in social, structural and systemic changes. In addition to addressing NCD risk factors, participants and communities can develop or strengthen their artistic and cultural identities, and become agents of change. Arts-based programs are often intrinsically multimodal, which can enhance the ability of interventions to move beyond individual-level strategies toward recognizing and addressing structural, systemic and social drivers. Arts-based programs and interventions are often designed to produce multiple tangible and visible outcomes. Examples include (1) narratives, such as stories, poems and plays, which can impact local health knowledge, systems and policies; (2) community spaces such as gardens or art exhibitions, which can introduce ongoing opportunities for gathering and organizing to address structural and systemic drivers and (3) educational or behavioral strategies, which can create new knowledge, attitudes or health behavior changes.

Arts participation is multimodal and can generate multidimensional outcomes or effects. Integrated findings point to the arts' capacity to support multiple health promotion goals at the same time—combining appeal, participation, communication and improved health outcomes⁵⁷. While targeting one outcome, such as increased physical activity through dance, interventions may simultaneously accomplish others, such as social connection and mental well-being. Notably, articles commonly reported on more outcomes than they sought to measure (Supplementary Note 3) and arts participation was found to enable simultaneous individual-level and group-level impacts^{51,65,67}.

Cocreation is a valuable mechanism in arts-based health promotion programs. Findings indicate the value of the arts for facilitating cocreation of (and within) interventions, which can support social cohesion, help individuals and groups reclaim or build personal and cultural identity, cultivate shared purpose and support mental well-being^{49,50,56,68}. They can also provide more varied ways for people to participate, inform and lead health communications and interventions.

Negative findings

Two articles reported negative findings. In a community gardening program, occasional participants experienced a substantial decrease in their sense of community compared to nonparticipants and regular participants⁵¹. Regular participants also reported higher levels of distress than occasional participants, noting that stronger ties can increase social obligation and thereby stress. A radio novella program created community tension related to lack of trust in intervention partners, local politics and power, and research design⁴⁶. This was mitigated by intentionally transparent communication efforts.

Discussion

This mixed-methods systematic review identified and synthesized 95 studies of arts-based programs and interventions for health promotion and prevention related to NCDs and their risk factors. Studies from 27 countries and diverse populations elucidate where and for whom these programs are being implemented, as well as how the arts are engaged to address NCD risk factors in community settings and promote health equity. Supporting previous evidence synthesis, our findings highlight how the arts are used for health communication and in active interventions to promote healthy behaviors such as physical activity and healthy diets^{63,69–71}, mental well-being and other outcomes. The review yielded unique insights related to the roles of cultural relevance in such programs, how the arts are used to identify and address systemic, structural and social drivers of health in communities and how the multimodal nature of the arts can enable multidimensional outcomes in health promotion efforts.

Health equity/systemic, structural and social drivers

Societal stratification is a fundamental cause of global health inequities^{5,6}. Structural factors, such as racism and ethnic discrimination, and systemic factors, such as policies, media and health systems, that are not designed for diverse users create socioeconomic hierarchies and power imbalances that impact access to resources, including healthcare, wellness services, financial resources and health knowledge. These upstream drivers contribute to inequitable quality of life and health outcomes, and increase risks of NCDs⁵. Upstream systemic, structural and social drivers of health also substantially influence health attitudes, opportunities and behaviors, subjecting some populations to greater risk of developing NCDs or seeking timely treatment^{5,6,9}. The limitations of downstream actions in achieving equitable health

improvements have been recognized globally, alongside the acknowledgment that intersectionality and social change are necessary to address upstream drivers and achieve health equity⁷².

Numerous articles included in this review sought to address health disparities and drivers of health among members of underserved or 'marginalized' groups—those experiencing exclusion due to sex identity, race, age, sexual orientation, physical ability and/or immigration status³⁵. Notably, the largest category of issues and outcomes addressed in these reviewed articles ($n = 84$) was systemic, structural and social drivers of health. In these studies, the arts were used to help identify and address these drivers by amplifying the voices of those affected, enhancing understanding of the effects of such drivers as racism or historical trauma, and supporting efforts to mobilize communities toward structural change. However, despite focusing on health inequities, some studies paid limited attention to upstream drivers. For example, a study of storytelling as a culturally aligned method of promoting colorectal cancer screening among Latina women mentioned this population's disproportionately high rates of obesity and cancer mortality, as well as its low screening rates, without mentioning or addressing the social/structural drivers of these issues⁷³. Instead, the intervention focused strictly on individuals' choices and behaviors. Despite potential positive impacts, highlighting health disparities without recognizing upstream factors risks reinforcing problematic perceptions that race/ethnicity is itself a cause of disparities. By contrast, a similar storytelling program to empower rural youth to understand and address cancer disparities referenced geography, environment, lack of education, poverty and mistrust as contributors to those disparities⁷⁴.

Recognizing that NCD prevention requires upstream and root-cause efforts, our findings highlight the need for additional interventions to address these issues, while also suggesting that arts-based interventions may offer more holistic, ecological approaches to health promotion and prevention across the social-ecological spectrum. Rather than accepting the premise of social disadvantage, those engaged in promoting health must consider how to effect change at the outer levels of the social-ecological model⁷⁵.

The review also emphasizes the importance of engaging members of the priority community of focus in the design and implementation of interventions. For example, a health communication program that framed type 2 diabetes (T2D) as a 'socioecological disease'⁵⁹ engaged youth poets from an ethnic minority background to develop the program's content. It subsequently increased public health literacy about T2D, including how complex, inequitable and multilevel forces interact to generate disease and disparities. Recognition of T2D as a social justice issue also increased participants' civic engagement.

This review suggests that the arts can increase the visibility of the systemic, structural and social forces that contribute to health disparities and inequities. They may also help to create conditions, such as awareness, connection and collaboration⁵⁹. Arts programs can be designed with social change in mind and can engage arts practices that yield inclusivity and agency^{59,64} or, conversely, engage the arts in ways that fall short of these critical aims.

Multimodal nature of the arts

The arts offer a multimodal approach capable of producing multiple and multidimensional outcomes^{18,21}. Arts participation is known to engage physical, emotional and cognitive processes. Whether enjoyable, evocative, challenging or disruptive, emotional engagement can be a mechanism of understanding and behavior change at both individual and collective levels^{60,76}.

Notably, some articles in this review describe multiple and residual outcomes related to systemic, structural and social drivers of health^{45,49,50,77,78}, indicating that the arts offer means for simultaneously addressing individual outcomes and systemic, structural and social drivers of health. Given limited health resources and persistent global

disparities in access to health promotion and prevention resources, the efficiency of the arts as an intervention is a substantial consideration. There is an opportunity for the arts to be better recognized and used as available, culturally grounded and particularly sustainable health promotion resources in communities, especially low-resource communities. However, issues of access related to financial and structural barriers must be addressed.

Cultural relevance

A key finding in this review is the importance of cultural relevance, which is important to both uptake and effectiveness in NCD prevention strategies. The arts may provide advantages in this regard as they can increase appeal and resonance, and naturally leverage cultural norms, practices and languages for health promotion, and thereby engagement and effectiveness.

Many studies in this review used the arts to adapt health communication to local, cultural and age-appropriate contexts. The use of culturally relevant media or platforms can optimize engagement, as can be capitalizing on existing cultural practices or interests, such as local community gardening, singing or crafting. Within health communication programs, the integration of shared cultural characteristics can enhance empathy and understanding of health beliefs and barriers. Traditional practices can also be engaged to meet the unique needs of specific populations, such as reconnecting with traditional foods and practices. Notably, findings indicate that cultural relevance can be optimized by engaging members of the priority community in intervention ideation, planning, design, implementation, evaluation and iteration.

Negative findings and adverse effects

In addition to the negative findings noted, some elements of interventions may cause adverse effects, such as characters in dramas exemplifying undesirable behaviors and inadvertently stigmatizing behaviors or people. This can be mitigated by providing better facilitator training and increasing the involvement and leadership of intended beneficiaries. While these problems are not unique to arts-based interventions, those engaging arts for health promotion should consider the power that the arts have to shift perceptions and assume responsibility to approach interventions and beneficiaries with cultural humility, critical pedagogy, intersectional awareness, shared leadership and awareness of potential harms^{79–81}. In addition, while this study did not specifically analyze differences or potential harms related to sex or gender, future studies should do so.

Strengths and limitations

This review recognizes the breadth of arts-based interventions as both a strength and a limitation. As a strength, it makes tailored and culturally relevant interventions more feasible. As a limitation, heterogeneity in interventions, measures and reporting poses challenges to evidence synthesis.

One strength of this review was its team of researchers from seven countries (Nigeria, Malawi, the United Kingdom, Singapore, the United States, Denmark and Australia), representing diverse disciplinary perspectives, including public health, nursing, medicine, the arts, creative arts therapies and arts in health. We applied a mixed-methods analysis that acknowledged diverse forms of knowledge by incorporating a broad range of insights and adopting an inclusive framework for critical appraisal, centered on equity and intersectionality. Our approach values forms of evidence that were potentially excluded from previous systematic reviews based on traditional evidence hierarchies. For example, the breadth of included programs and evidence demonstrates an intentional effort to acknowledge the existing range of program approaches and the diverse, meaningful insights therein to answer our research questions.

One limitation was that the World Health Organization's 5 × 5 framing of NCD prevention includes mental ill-health as an NCD but

lacks directly correlating risk factors. To account for this and ensure the inclusion of studies addressing mental ill-health, we focused on systemic, structural and social drivers of health as risk factors for mental ill-health and included articles that measured mental well-being. Our search strategy included terms reflecting this framing. We also recognize that the rhetoric of the 5 × 5's presentation of risk factors creates its own structural effect on health outcomes by privileging some risks (for example, behaviors) while omitting others (for example, structural and environmental factors) and thus affects what is studied globally.

Another potential limitation was the exclusion of programs addressing NCDs but not their risk factors, which may have provided important examples. In addition, the wide range of duration and frequency in the interventions (Supplementary Note 3) limits ability of evidence synthesis to demonstrate long-term impacts. Only 16 studies were reported on interventions lasting more than 8 weeks. Future research should include longitudinal designs with longer follow-up to understand the sustained value of the arts, particularly in low-income and middle-income countries (LMICs). Finally, as NCDs disproportionately affect LMICs, future research should examine the applications and effects of the arts in these countries.

Risk of publication bias

All 16 databases searched were global, and articles in any language were included (Extended Data Table 6). The team of researchers who screened articles were located across four different countries in Asia, Africa and North America, with half in North America. The disproportionate rate of U.S. studies may be due to differences in the availability/representation of data from various geographical locations, resulting from variations in research and publication resources^{82,83}. To mitigate bias, this review included bias assessment of each. More studies from LMICs are needed to increase cultural diversity and global representation.

Value and implications of this study

This systematic review of evidence addresses a gap in the current understanding of the use of the arts for health promotion and the prevention of NCDs in nonclinical populations worldwide. It calls attention to the structural and systemic enablers and barriers to the uptake of the arts in these programs, and to how these programs address issues of health equity. The review contributes insights related to the roles of cultural relevance in these programs, how the multimodal nature of the arts can enable multidimensional outcomes and how the arts can help address health equity and systemic, structural and social drivers of health. The findings can help to inform design, implementation and measurement of arts-based NCD prevention and health promotion programming globally. It can also guide use of the arts to enhance cultural relevance and community engagement, and help programs better address social, systemic and structural drivers of health. As NCDs disproportionately impact LMICs, more studies from these countries are needed to improve global representation and understanding.

Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at <https://doi.org/10.1038/s41591-025-03962-7>.

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Methods

This mixed-methods systematic review followed the Joanna Briggs Institute Manual for Evidence Synthesis (2024) guidelines for mixed-methods systematic review using a convergent approach to synthesis and integration⁵⁸.

Protocol and registration

The review's methodology followed the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)'⁹⁴. To prevent replication, a search for related reviews or protocols was conducted on October 31, 2023. Six similar reviews were identified, but none examined evidence regarding the use of the arts to address NCDs in communities, as defined in this review. The review protocol followed PRISMA-P⁹⁵ and was registered with PROSPERO⁶². The IRB approval was not sought, as this study did not involve human participants.

Definitions and frames

NCDs and risk factors. This review used the World Health Organization's 5 × 5 approach to NCDs prioritization⁹⁶, which identifies CVD, cancer, diabetes, chronic respiratory diseases and mental ill-health as the most prevalent NCDs. Key associated risk factors include tobacco use, unhealthy diets, physical inactivity, harmful use of alcohol and air pollution¹. To this, we added systemic (for example, government, media), structural (for example, racism, socioeconomic inequity) and social (for example, social/cultural norms, language barriers) drivers/determinants of health, along with mental well-being^{52,97–99}. These additions allowed for consideration of risk factors such as war, disasters and other social and environmental factors.

The review used specific definitions for health promotion and prevention¹⁰⁰, arts participation³³, marginalization³⁴, health equity^{91,101–103}, structural and systemic drivers of health^{102,104} and social drivers of health¹⁰⁵ (Extended Data Table 1).

Framing. This review was theoretically framed by the social–ecological model of health, which recognizes interactions between individuals and their community, physical, social and political environments^{53,54}, including access to resources. Given the impact of social, systemic and structural drivers on NCD incidence globally, we used intersectionality to consider complex experiences and to account for interactions among factors such as social locations, race, class, and systems and structures of power (for example, governments, media) in our qualitative analysis and data integration¹⁰⁶.

Search strategy and selection criteria

Original, peer-reviewed research articles were considered eligible; reviews, dissertations, protocols, proceedings and popular media were excluded (Extended Data Table 1). No language or publication date limits were imposed. The strategy engaged population, intervention, context, outcomes, study types (PICOS) characteristics (Extended Data Table 7).

Information sources

A preliminary search strategy was developed using the pearling technique⁵⁵ and tested through PubMed, Scopus and Web of Science from 16 October 2023 to 19 January 2024. This strategy was peer-reviewed by two additional health sciences librarians and a public health specialist using Peer Review of Electronic Search Strategies¹⁰⁷. Final searches were conducted between February 9 and 15, 2024. To minimize selection bias, 15 bibliographic databases, as well as Google Scholar, were searched. Relevant database subject headings were used in addition to truncated and phrase-searched keywords within the title and abstract fields. No limits or filters were applied. The search strategies are available in searchRxiv¹⁰⁸ and in Supplementary Note 4. This search generated 10,168 results, which were exported into Covidence (version 2024) and automatically deduplicated.

In March 2024, five journals not indexed in the bibliographic databases were hand-searched, adding 52 references. Gray literature searching was conducted in February 2024, resulting in the addition of 97 references. After screening for inclusion on 8–9 April 2024, backward citation tracking was performed using the bibliographies for all included articles ($n = 95$), resulting in the addition of 189 references. See Extended Data Table 6 for all search sources and Supplementary Note 5 for excluded articles.

Selection and risk of bias and quality assessment

Independent blinded pairs of researchers located in four different countries screened the title, abstract and full-text papers in Covidence against inclusion criteria. Agreement was required between the two reviewers with a third reviewer resolving conflicts. Two blinded individual reviewers assessed the risk of bias and appraised the quality of each study using a quality assessment tool for diverse studies¹⁰⁹. A third reviewer facilitated concurrence related to inclusion.

Data analysis and integration

Twenty-nine categories of data were extracted manually by two independent researchers, assisted by an artificial intelligence (AI) copilot designed for 20 categories¹¹⁰ (Supplementary Note 6). Three researchers verified the accuracy of all AI work. Analysis was guided by research questions, PICOS and PICOS mnemonics to uncover phenomenon of interest, outcomes, context and themes. Quantitative data (numeric) and qualitative data (for example, themes/quotes from interviews and focus groups) were analyzed separately before integration.

Qualitative data from qualitative ($n = 12$) and mixed-methods ($n = 16$) studies were analyzed using thematic synthesis³⁹. Themes were manually extracted from the qualitative findings of each study ($n = 28$) by two researchers independently. AI assisted with data grouping, following which seven researchers independently reviewed and refined themes across the articles, with two researchers drawing from each article (Supplementary Note 3). A third researcher extracted and reviewed themes to ensure accuracy and translation of findings across contexts. Conceptual links among themes were identified through dialog and integrated into a final set of analytic themes, which were reviewed independently, and then discussed, with seven researchers engaging in cyclical dialogic process to refine themes and achieve consensus³⁹. After consensus, the themes were summarized into aggregated statements, along with relevant subthemes. Quantitative and qualitative evidence was then compared using a joint display^{42–44} (Extended Data Table 5) for back-and-forth exchanges⁴¹ to corroborate, link and diffract qualitative themes and quantitative constructs, resulting in a set of key findings.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

Primary extracted data for the included studies referenced in this article are available in Supplementary Note 3. All data are available on figshare.

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Author contributions

J.S., D.F., N.S. and K.W. conceived the project. J.S., M.K.B.T., J.B.L., V.P., J.M.-D., M.P. and D.F. designed the study and developed the methodology (with review by all authors). J.S., J.B.L., M.K.B.T., T.G., S. Akram, S. Abdulla, C.P., S.O., J.M.-D. and V.P. conducted the search. Specifically, J.S., M.K.B.T., S.O., S. Akram, S. Abdulla, V.P. and J.B.L. contributed to data screening and extraction, with support from G. Hammond, Y. Chen and A. Colverson. J.S., M.K.B.T., J.B.L., T.G., V.P., S.O., S. Akram and S. Abdulla conducted the data analysis. J.S., M.K.B.T., J.B.L., V.P., J.M.-D., S. Akram and D.F. developed the first draft of the manuscript. J.S., J.B.L., M.K.B.T., D.F., S.A., J.J.M., N.S., M.P., C.P., J.M.-D., V.P., K.W. and J.J.M. contributed to reviewing and editing the manuscript. J.M.-D., C.P., S.O. and J.B.L. managed citations. All authors approved the final manuscript. J.S. supervised the study and secured funding.

Competing interests

N.S. is employed by NYU and serves as the principal investigator on the primary award associated with the subaward provided for this project by NYU. The other authors declare no competing interests.

Additional information

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Correspondence and requests for materials should be addressed to Jill Sonke.

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Extended Data Table 1 | Eligibility criteria and definitions used

Eligibility Criteria and Definitions Used

Inclusion and Exclusion Criteria	
Note: Inclusion criteria are based on a Population, Intervention, Context, Outcomes, and Study Types (PICOS) framework.	
Inclusion Criteria	• Studies involving human populations of all ages. • Studies involving general populations (not diagnosed with NCDs) in any geographic location. • Articles that describe arts-based programs, practices, or activities in alignment with the definition of arts participation for public health research offered by Sonke et al, 2023. • Studies that report on programs, practices, or activities that take place in a community setting outside of a health facility (e.g., a senior living community, prison, school; could be conducted by a clinic or hospital, but in a community setting). • Articles that address health promotion or prevention related to NCD risk factors, in accordance with the study's guiding definitions: Tobacco use, unhealthy diets, physical inactivity, harmful use of alcohol, air pollution, and social drivers of NCDs, including structural, systemic, or social conditions that influence health and/or health equity • Studies that report on program models or program outcomes (including evaluations and research). • Original research studies (quantitative, qualitative, or mixed methods), reports, and gray literature. • Peer-review journal or other credible sources including universities, professional organizations, governmental, and global organizations (i.e., the World Health Organization). • Articles published in any year through 2024.
Exclusion Criteria	• There are no exclusions based on age, gender, sexual orientation, religion, ability, race, ethnicity, nationality, legal status, economic status, or country of residence. • Evidence synthesis reviews, dissertations, protocols, conference proceedings, or news and popular media sources. • Articles that do not meet eligibility criteria above. • Articles that do not meet quality appraisal criteria (using the Quality Assessment with Diverse Studies tool).
Definitions Used in the Study	
Health Promotion and Prevention	The process of enabling people to increase control over, and to improve their health. (WHO, 2024)
Arts Participation	A broad range of modes (ways in which people engage, including informal, formal, live, virtual, individual, and group participation) and forms (artistic practices or disciplines with which people engage), including various ways in which people can engage with the arts, including as makers/creators, performers, collaborators, audiences / observers, and consumers (Sonke et al., 2023).
Marginalization	A "multidimensional, dynamic, context-dependent, and diverse web of processes, rooted in power imbalance and systematically directed toward specific groups and individuals, with probabilistic implications for development" (Causadias & Umaña-Taylor 2018).
Health Equity	The principle that everyone has a fair and just opportunity to be as healthy as possible (RWJF, 2017; Braveman et al., 2018). Health equity requires identifying and eliminating obstacles to health, including disparities among socially, economically, demographically, or geographically defined groups, and involves addressing social determinants of health as well as their structural and systemic determinants or drivers (Wendel et al., 2024; Hofrichter & Rajiv Bhatia, 2010).
Structural and Systemic Drivers of Health	The fundamental forces that shape the distribution of resources, risks, and power in society. They operate at multiple levels of the social-ecological model and include policies, economic systems, social norms, political structures, and socio-historical narratives that create and maintain disparities in health outcomes across different populations (Wendel et al., 2024, Brown & Horman, 2023).
Social Drivers of Health	The non-medical factors that influence health outcomes (WHO, 2024). They are the conditions in which people are born, grow, live, work, play, worship, and age (e.g., income, social protection, education, food access, social inclusion), and are shaped by factors such as distribution of money, power, and resources as well as economic, political, and social policies, systems, and norms.

Table of eligibility criteria and definitions used in the study.

Extended Data Table 2 | Study designs and number of studies for each**Study Designs and Number of Studies for Each**

Study Design	Number of Studies
<i>Randomized controlled trials (total n=16)</i>	16
<i>Quasi-experimental designs (total n=26)</i>	
Non-randomized experimental study	21
Quasi-experimental	3
Two-group randomized, brief intervention pilot study	1
Mixed methods randomized study	1
<i>Correlational designs total (total n=17)</i>	
Cross sectional study	12
Cohort study	4
Observational longitudinal study	1
<i>Descriptive designs (total n=3)</i>	
Case series	1
Quantitative research method	1
Program evaluation	1
<i>Participatory research (total n=5)</i>	
Community-based participatory research (CBPR)	2
Participatory action research (PAR)	1
Community-based prevention marketing (CBPM)	1
Community-Based Research (CBR)	1
<i>Mixed methods (total n=16)</i>	16
<i>Qualitative research (total n=12)</i>	12

Study designs and number of included studies in each category.

Extended Data Table 3 | Modes and forms of arts engagement**Modes and Forms of Arts Engagement**

Modes: <i>Ways in which people engage, including informal, formal, live, virtual, individual, and group participation</i>	Number of Studies
Creating, practicing, performing, and sharing art	28
Attending live arts and cultural events and activities	25
Participating in social, civic, spiritual, and cultural arts practices	20
Learning in, through, about the arts	20
Consuming arts via electronic, digital, or print media	14
Forms: <i>Art forms or disciplines with which people engage</i>	
Visual Arts, Craft, and Design	36
Music	22
Dance/Movement	20
Theater/Performance	18
Literary Arts	15
Media	13

Note: Some studies reported multiple modes and/or forms.

Modes and forms of arts participation represented in the included studies.

Extended Data Table 4 | Quality appraisal criteria and scores**Quality Appraisal Criteria and Scores**

QuADS 2021 Quality Assessment	Quality Assessment Score			
	0	1	2	3
Theoretical or conceptual underpinning to the research	2	14	27	52
Statement of research aims	0	16	10	69
Clear description of research setting and target population.	0	7	30	58
The study design is appropriate to address the stated research aim/s	2	1	32	60
Appropriate sampling to address the research aims	16	24	23	32
Rationale for choice of data collection tools	6	11	33	45
The format and content of data collection tool is appropriate to address the stated research aims	1	13	24	57
Description of data collection procedure	1	17	16	61
Recruitment data provided	1	31	19	44
Justification for analytic method selected	12	13	26	44
The method of analysis was appropriate to answer the research aims	3	9	19	64
Evidence that the research stakeholders have been considered in research design or conduct.	37	25	16	17
Strengths and limitations critically discussed	8	11	32	44

Note: Refer to QuADS 2021 for additional information on assessment scores

Quality appraisal criteria used and scores.

Extended Data Table 5 | Joint display

Joint Display			
Note: Blue lines indicate linking, augmenting, or corroborating and red lines indicate diffraction or disagreement			
QUANTITATIVE: MM + QUAN papers (n=79)		QUALITATIVE: MM + QUAL Papers (n=34)	
Research Questions	Constructs	Themes	Research Questions
What is the evidence for use of the arts in health promotion and prevention of non-communicable diseases (NCDs) in the general (non-clinical) population globally?	NCDs: Prevalence of studies on CV disease (n=54), diabetes (n=41), and mental ill health (n=37).	The arts can enable - and often reflect - community collaboration, ownership & co-creation	Q2. What are enablers and barriers, including structural and systemic, to uptake of the arts in health promotion and prevention of NCDs in the general (non-clinical) population globally?
	NCDs: Cancer, chronic respiratory disease, brain health, dementia, and PD were represented on a smaller scale.	Community involvement in program design and implementation is necessary.	
	Risk Factors: Physical inactivity = 44	Participatory arts practice and research methods (e.g., community advisory boards and youth engagement) enable incorporation of local knowledge and expertise and increase relevance.	
	Risk Factors: Unhealthy Diets = 22	There are sometimes disjunctions and gaps between intended and actual community collaboration.	
	Risk Factors: Tobacco and alcohol use = 3	The arts provide a useful frame for bringing cultural relevance to health promotion and prevention programs	
	Risk Factors: Systemic, structural and social drivers = 118 (majority were structural = 88 of 95)	Cultural Values, Norms, and Practices should be incorporated into programs and practices.	
	Risk Factors: Mental Wellbeing: 33	Communication strategies and platforms should be culturally-specific.	
	Study types: Approximately 70.6% (n=67) of studies were quantitative, 16.8% (n=16) were mixed methods designs, and 12.6% (n=12) were qualitative. A wide range of designs, methods, and reporting were represented among these (high)	Culture is a vehicle for health promotion.	
	Types of Interventions: 52% of articles (n=49) reported on health communication programs; 48% (n=46) articles reported active interventions.	Cultural identity and representation are critical to health promotion and should be defined and guided by community members.	
	Arts Forms Used in Interventions: Visual Arts, Craft & Design = 36 programs Music = 22 programs Dance/Movement = 20 Theatre/Performance = 18 Literary Arts = 15 Media = 13	Financial and structural resources are a challenge to arts-based interventions	
	Modes of Engagement: Creating, practicing, performing, and sharing art = 28 Attending live arts and cultural events and activities = 25 Participating in social, civic, spiritual, and cultural arts practices = 20 Learning in, through, about the arts = 20 Consuming arts via electronic, digital, or print media = 14	Resource allocation for arts-based interventions can be challenging.	
	Outcomes Reported: Unhealthy diets = 21	Lack of resources and stakeholder buy-in limit sustainability of arts-based interventions.	
	Outcomes Reported: Systemic, structural and social drivers of health = 118	Arts programs were developed in recognition of, or helped to identify, health disparities and inequities.	
		Many arts-based programs/interventions were based on data that illuminated NCD-related health disparities and inequities, such as disproportionate prevalence of obesity, diabetes, cardiovascular diseases, hypertension, etc., among specific populations.	
	Outcomes Reported: Mental/psychological health = 27	For many or for certain program designs, and in particular contexts, recognition of disproportionate impacts of mental ill health and behavioral issues among particular populations, as well as food deserts, limited access to healthy foods, and barriers to mental health support in particular regions, such as low-income or rural areas.	
	Outcomes Reported: Physical Activity = 44	Arts programs can be designed to address systemic, structural, and social drivers of health.	Q3. How have strategies for incorporating the arts addressed issues of health equity in health promotion and prevention of NCDs in the general (non-clinical) population globally?
Q1: Where are the arts being used globally for NCD prevention and health promotion?	Statistically Significant Outcomes: BMI (n=6)	Arts program/intervention design, implementation and measurement often recognized and sought to respond to systemic, structural and social drivers of health, such as the effects of historical and collective trauma, adverse childhood experiences, social exclusion, lack of transportation, lack of land tenure, etc.	
	Statistically Significant Outcomes: Fruit/veg intake (n=8)	Many arts programs/interventions: 1) elevated the voices of those affected by marginalization, displacement, erasure, etc., to describe and address these experiences; 2) promoted community-based program participation as an opportunity for community improvement and mobilization.	
	Statistically Significant Outcomes: Mental Health (n=5)	Cultural relevance supports access in health promotion programs.	
	Statistically Significant Outcomes: Exercise (n=3)	Culturally relevant media or platforms (e.g., radio for Hispanic immigrants, hip hop for youth) can be used to support communication and engagement.	
	71 studies reported desirable outcomes, most commonly physical health metrics, dietary changes, and knowledge; 20 studies reported neutral outcomes, mostly related to physical and mental health; and one study reported undesirable outcomes, related to sense of community.	Culturally relevant art forms can encourage and increase participation.	
	Setting: A majority (57%) of quantitative and mixed methods studies took place in schools followed by in community and in community centers.	Many arts programs/interventions enhance health communication by incorporating traditional or culturally specific and significant practices, histories, and narratives.	
	Geography: 26 countries are represented.	Arts programs/interventions can shift discourse and perceptions and can be particularly useful in enabling dialogue around health issues, communicating complex health information, and addressing difficult topics such as negative perceptions of NCDs.	
	Age groups: A majority of studies included children and youth ages 6-17 (n=49; 51.57%) followed by adults (n=30; 31.57%) and older adults 50+ (n=18; 18.94%). Six studies included preschool children ages 0-5, and some studies reported	The arts are multimodal and can produce multiple, and multidimensional, outcomes.	
		Arts activities designed to increase physical activity can also increase emotional engagement, enjoyability and provocation, cognitive engagement, social connectedness, "shared" experiences, skill and knowledge sharing, and creative and sensory engagement.	
	Race, Ethnicity, Indigeneity: 64% (n=61) of articles reported race; 36% (n=34) of articles did not report race. Among those that reported race, 84% of intended beneficiary groups were global majority or regionally minoritized.	Arts-based programs/interventions can yield social connectedness from the multidimensional aspects of engagement and the co-creation of experiences, products, and spaces. Social connectedness may serve as a protective factor and can promote engagement and participation in social, structural, and systemic changes.	
		Participants and communities can develop or strengthen their artistic and cultural identities and become agents of change via the multimodal nature of arts participation.	
		Arts-based programs are often intrinsically multimodal, which can enhance the ability of interventions to move beyond individual-level strategies towards recognizing and addressing structural, systemic, and social drivers.	
		Multidimensional outcomes of arts-based programs and interventions can be exemplified by narratives, such as stories, poems and plays, which can impact local knowledge, systems and policies.	
		Arts exhibitions and gardens can create, or activate, community spaces and introduce tangible and visible opportunities for ongoing community gathering and organizing	
		Arts-based programs/interventions enhanced educational or behavioral strategies, which can create new knowledge, attitudes or health behavior changes.	

Joint display table, including all quantitative constructs and qualitative themes, used for back-and-forth exchanges in the data integration process.

Extended Data Table 6 | Databases searched

Databases Searched	Hand-searching
Cochrane Library (1996–Present) EBSCOhost Alt HealthWatch (1984–Present) EBSCOhost Art and Architecture Source (1914–Present) EBSCOhost CINAHL (1976–Present) EBSCOhost Communication and Mass Media Complete (1901–Present) EBSCOhost Performing Arts Periodicals Database (1864–Present) EBSCOhost Psychology and Behavioral Sciences Collection (1930–Present) EBSCOhost PsycINFO (1600–Present) Elsevier EMBASE (1947–Present) Elsevier Scopus (1788–Present) National Library of Medicine PubMed (1800–Present) ProQuest Applied Social Sciences Index and Abstracts (ASSIA) (1987–Present) ProQuest ERIC (1966–Present) ProQuest Performing Arts Periodicals Database (1864–Present) Web of Science Clarivate Analytics (1900–Present) Google Scholar (1995–Present)	Journals: • Arts and Health • Nordic Journal of Arts, Culture, and Health • International Journal of Music, Health, and Wellbeing • Public Health • Health Promotion Practice Web Archives & Databases: • Alliance for the Arts in Research Universities • Arts & Health, the University of Florida Center for Arts in Medicine Research Database • National Endowment for the Arts

Table of databases searched, including hand searching.

Extended Data Table 7 | PICOS framework

PlcOS Framework	
PlcOS Framework	
P (population)	General non-clinical populations (not individuals diagnosed with NCDs), of all ages, in all locations
I (intervention)	Arts participation and arts-based programs, practices, or activities
c (context, no comparator)	Tobacco use, unhealthy diets, physical inactivity, harmful use of alcohol, air pollution, and social drivers of NCDs
O (outcomes)	NCD and NCD risk-factor prevention; NCD and NCD risk-factor health promotion; health literacy, attitudes, awareness, stigma, taboos, health behaviors related to NCDs and NCD risk factors
S (study types)	All study types and methodologies reported in original, peer-reviewed and grey literature research studies

PICOS framework used for the study.

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☒	☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
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☒	☐ For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
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All extracted data is presented in Extended Data Fig. 7. Extracted Data_All Studies

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Reporting on sex and gender

This study did not specifically analyze differences or potential harms related to sex or gender.

Reporting on race, ethnicity, or other socially relevant groupings

Numerous articles included in this review sought to address these disparities and drivers of health among members of underserved or "marginalized" groups - those experiencing exclusion due to gender identity, race, age, sexual orientation, physical ability, and/or immigration status.³⁵ Notably, the largest category of issues and outcomes addressed in reviewed articles (n=84) was systemic, structural, and social drivers of health.

Population characteristics

Twenty-seven countries were represented across the data, with 59 studies of populations in the US, 10 in the UK, and 9 in Australia.

Recruitment

All databases searched were global, and articles in any language were included. The team of researchers who screened articles were located across four different countries in Asia, Africa and North America, with half in North America.

Ethics oversight

Note that full information on the approval of the study protocol must also be provided in the manuscript.

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Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size

Data exclusions

Replication

Randomization

Blinding

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description

The arts for NCD prevention and health promotion: A mixed methods systematic review

Research sample

A total of 233,718 research participants from 10 racial/ethnic groups and a range of ages were represented in the 95 studies (See Table 2). Global majority and/or regionally minoritized/marginalized groups were a focus of study across most articles.^{34,35} Thirty-four articles did not report race or ethnicity, and numerous included more than one group.

Sampling strategy

10,168 studies were identified through the database searches, of which 78 met inclusion criteria. (See Extended data fig.1 Inclusion Exclusion Criteria). 17 were then identified through hand searching or snowballing resulting in a final sample of 95 studies.

Data collection

A preliminary search strategy was developed using the pearling technique⁵⁵ and tested through PubMed, Scopus, and Web of Science from October 16, 2023-January 19, 2024. In March 2024, five journals not indexed in the bibliographic databases were hand-searched, adding 52 references. Grey literature searching was undertaken in February 2024 adding 97 references.

Timing

October 2023-February 2024

Data exclusions

Inclusion and exclusion criteria are available in extended data figure 1.

Non-participation

N/A

Randomization

N/A

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	
Research sample	
Sampling strategy	
Data collection	
Timing and spatial scale	
Data exclusions	
Reproducibility	
Randomization	
Blinding	

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☒	☐ Animals and other organisms		
☒	☐ Clinical data		
☒	☐ Dual use research of concern		
☒	☐ Plants		

Antibodies

Antibodies used	
Validation	

Eukaryotic cell lines

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Cell line source(s)

Authentication

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☒	☐ National security
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☒	☐ Confer resistance to therapeutically useful antibiotics or antiviral agents
☒	☐ Enhance the virulence of a pathogen or render a nonpathogen virulent
☒	☐ Increase transmissibility of a pathogen
☒	☐ Alter the host range of a pathogen
☒	☐ Enable evasion of diagnostic/detection modalities
☒	☐ Enable the weaponization of a biological agent or toxin
☒	☐ Any other potentially harmful combination of experiments and agents

Plants

Seed stocks	
Novel plant genotypes	
Authentication	

ChIP-seq

Data deposition

- ☐ Confirm that both raw and final processed data have been deposited in a public database such as [GEO](#).
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Data access links <i>May remain private before publication.</i>	
Files in database submission	
Genome browser session (e.g. UCSC)	

Methodology

Replicates	
Sequencing depth	
Antibodies	
Peak calling parameters	
Data quality	

Flow Cytometry

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Methodology

Sample preparation

Instrument

Software

Cell population abundance

Gating strategy

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Magnetic resonance imaging

Experimental design

Design type

Design specifications

Behavioral performance measures

Imaging type(s)

Field strength

Sequence & imaging parameters

Area of acquisition

Diffusion MRI

☐ Used

☐ Not used

Preprocessing

Preprocessing software

Normalization

Normalization template

Noise and artifact removal

Volume censoring

Statistical modeling & inference

Model type and settings

Effect(s) tested

Specify type of analysis: ☐ Whole brain ☐ ROI-based ☐ Both

Statistic type for inference

(See [Eklund et al. 2016](#))

Correction

Models & analysis

- | | |
|--------------------------|---|
| n/a | Involvement in the study |
| ☐ | ☐ Functional and/or effective connectivity |
| ☐ | ☐ Graph analysis |
| ☐ | ☐ Multivariate modeling or predictive analysis |

Functional and/or effective connectivity

Graph analysis

Multivariate modeling and predictive analysis

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