**What is the impact of the living environment on human health? A systematic map protocol**

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**Abstract**

Background:

Natural and built features in the living environment can impact public health and well-being. There are numerous studies on the relations between the living environment and health, but it remains unclear how to design a living environment which takes into account health promoting aspects (e.g. physical activity) as well as limiting health risks (e.g. environmental stressors) in a holistic manner.

Methods:

This protocol describes how a scoping review on the impact of the physical (natural and built) living environment on health can be performed in order to collect and summarize the recent scientific knowledge on this topic. After identifying the research question, conceptual frameworks and expert consultations helped to identify key topics and set the eligibility criteria. Additionally, four scientific databases were searched to identify the relevant publications. For the study selection, title, abstract and full-text screening were performed whilst labelling key topics. By using text mining, data on for instance study design, elements in the living environment and health outcomes can be charted. The results can be summarized to present knowledge gaps in order to inform researchers about further needs of research. Moreover, this overview could help informing professionals about the characteristics and design of a living environment that promotes health and prevents diseases.

1. **Background**

Numerous studies indicate that the living environment impacts health and well-being in various ways (1-7). Natural and built environmental features such as green and blue infrastructure have been linked to promote healthy behaviour as it may stimulate physical activity and social cohesion (5, 8-12). Conversely, environmental stressors such as air pollution, crowding and noise can adversely affect the health of residents (13-15). A living environment that promotes healthy behaviour is of great importance for public health as the major health impacts, such as mental health, obesity and cardiovascular diseases are related to an unhealthy lifestyle (16, 17). When designing a living environment, it should protect health as much as possible by reducing possible environmental risks and take into account health promoting determinants.. There are still many knowledge gaps on the influence of the living environment on health, especially regarding the interrelatedness of its key elements and pathways. Research on the living environment and health is often limited to cross-sectional studies, which do not provide sufficient information to derive causal relationships. In addition there is a lack of studies that investigate the (long-term)effectiveness of interventions that contribute to a healthy living environment (2, 18). Knowledge is diverged across domains (19). Most published work focuses on one aspect or topic of the healthy living environment, such as noise (20) or green space (Yang, Zhao et al. 2021), without considering the interactions with other environmental health determinants.

To design a healthy living environment it is important to understand how the physical living environment influences the health and well-being of citizens, in particularly how various physical aspects interrelate to health (21). An overview of the risks and impacts of the living environment on health could help researchers in health impact assessments. Sharing of knowledge among public health advisors, researchers and urban planners can help gaining a better understanding of promoting a healthy living environment (19, 22). Since knowledge is dispersed, there is need for a holistic overview (2). By doing a systematic scoping review a broad and thorough examination of recent literature on the impact of the physical living environment on health and well-being can be achieved. The scoping review can help to inform professionals in the design of a living environment that promotes health and prevents diseases.

**Aims and objectives**

This protocol aims to describe the methods for conducting a broad scoping review on research fields (e.g. healthy living environment or climate change) that entail a large variety of topics. These methods include the literature search, data extraction and data synthesis. This protocol explains how this scoping review can map and synthesize recent scientific knowledge on the impact of the living environment on health and well-being. The knowledge collected in this scoping review can be used to identify knowledge gaps to explore further needs of research.

1. **Definition of “health” and the “living environment”**

For the scoping review, we define health and well-being as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (23). Additionally, we extend the definition of health and well-being with “the individual’s ability to cope with physical, emotional or social challenges as well as an individual’s perceived quality of life and well-being” (24).

We define the living environment as our surrounding public outside space that encompasses both natural and built (physical) environment that can influence our health and well-being (25). Moreover, the living environment is dynamical and thus can change over time and space.

A healthy living environment is clean and safe, it facilitates social interaction, recreation, playing and exercising, as well as healthy mobility, such as walking, biking and the use of public transportation. A living environment should facilitate interactions within neighbourhoods and increase people’s sense of belonging. In addition, a healthy living environment is of good environmental quality including sound, air, soil and external safety aspects (26). Furthermore, a healthy living environment is characterized by sufficient amounts of green, water and nature and incorporates climate change adaptation measures. Moreover, a healthy living environment considers the needs of specific population groups such as residents with lower socio-economic status, children, elderly and people with chronic diseases or disabilities. It offers attractive and diverse open spaces as well as healthy and sustainable environments. Besides, a healthy living environment includes a variety of facilities and amenities, such as schools, shops, public transport, culture, and sport facilities (27).

1. **Scope**
	1. **Concept**

The concepts of the “living environment” and “health” formed the conceptual framework (figure 1), which represent a base for the scoping review. The living environment consists of elements and/or characteristics in the natural and built environment. Furthermore, we differentiated between impacts of the living environment on intermediate health outcomes and direct health and well-being outcomes. Intermediate health outcomes are lifestyle or behavioural factors such as tobacco use, physical activity, healthy nutrition, social activities (e.g. participation and social interaction, restoration) or environmental risk factors such as exposure to environmental pollutants or infectious agents. Intermediate health outcomes also include community social capital, social safety and social cohesion, which we refer to as social neighbourhood environment. Under direct health outcomes we comprehend disease-specific or general health measures such as disease incidence or prevalence (e.g. obesity, cardiovascular disease), self-reported health and well-being, mortality or integrated health metrics such as DALYs (28).



Figure 1 Conceptual framework of the scope of this review

To thematically assess the knowledge on the living environment and health, key topics on the healthy living environment were identified based on conceptual frameworks and expert consultations (figure 1), see the appendix for a description list of the key topics (29-35).

**4.2. Context**

Regarding the living environment within the scoping review, we intended to focus on public spaces, meaning public outdoor environments and access to public services and facilities. This could entail parks or urban infrastructure, but not working environments (i.e. occupational risks) or indoor housing quality. The scope of the living environment was set on the Dutch context. We did not limit the search to studies performed in the Netherlands, but instead included studies done in countries where aspects of the living environment are comparable to the Dutch context. Subsequently, we aimed to provide a broader knowledge base than only Dutch studies can provide.

**4.3. Study population**

We aimed to map the existing knowledge on the relations between the living environment and health for all people living in and using the outdoor environment. Vulnerable groups may be disadvantaged because they often have more limited access to health promoting opportunities in the living environment or are more susceptible to suffer from disease (36, 37). They might also be more exposed to risk factors such as environmental pollution, crime, neighbourhood disadvantage or deprivation (38, 39). Homeless people were regarded out of the scope as they face other exposure or health problems that are not comparable with the general population using the living environment. We took vulnerable groups into special consideration by labelling studies which look at e.g. elderly, children, vulnerable socio-economic groups, people with disabilities, immunocompromised or minority groups.

1. **Systematic approach**

To guide this scoping review, the steps of the Arksey & O’Malley framework were used (Arksey & O’Malley, 2005, Levac, D., Colquhoun, H. & O'Brien, K.K. (2010). These steps include (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, (5) collating, summarizing and report results, and (6) consultation (figure 2). Expert consultations were conducted in the first stage of the review process to sharpen the search strategy by determining relevant concepts, frameworks and topics, keywords, and eligibility criteria.



Figure 2 Steps of the scoping review

The eleven consulted experts have research experience on specific fields of the relationship between the living environment and health. Their expertise entails noise, green space, blue space, biodiversity, climate (change), physical activity, healthy mobility, social environment, food environment, air quality and health-promoting aspects of the living environment. Along the scoping review process, four experts from the project group with different backgrounds were involved to assist in the interpretation of the research findings and comment on the report. The reviewing process was conducted by two independent researchers. The scoping review was documented following the Preferred Reporting Items for Systematic reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) checklist from Tricco, Lillie (40) was used. According to Lockwood, dos Santos (41) this approach helps maintaining the best practice standard.

1. **Search strategy**

The focus of this systematic scoping review lies on sensitivity rather than specificity, meaning that it maintains a broad scope. The search was based on the main concepts “health” and “physical living environment”, as also shown in the conceptual framework (figure1). We were also interested in studies in which the interconnection between the physical and social neighbourhood environment (i.e. community social capital, social safety and social cohesion) on health was examined, in which the social environment is classified as an intermediate outcome. We aimed to retrieve articles of the combination of “health” and “physical environment” (figure 3, B) or all the three concepts of “health”, “physical environment” and “social environment” (figure 3, A). The combination of “health” and “social environment” was considered out of the scope of this review (figure 3, C) as it did not intend to investigate how the design of the social living environment can influence health (figure 3, C).



Figure 3 Diagram of the search strategy including the three concepts “health”, “physical environment” and “social environment”

Concepts terms health and physical environment were applied to maintain a sensitive search, whilst entailing the major topics for the “health” concept (table 1). Additional terms which were found relevant by the consulted experts but did not exist as a concept term in the databases, were searched as “text word”. The full search queries can be found in the appendix. The search was critically appraised by two reviewers, by checking whether key articles (proposed by experts) were retrieved in the search. Keywords of these key articles were additionally considered. The search strategy was discussed with a librarian to optimize the search.

1. **Information sources**

The scientific databases searched were Embase, Pubmed, Scopus and PsychInfo. By combining these four databases we intended to incorporate a variety of studies from the fields of medicine, biomedical, behavioural and social science. These databases were expected to cover the majority of relevant scientific literature on the association between the design of the living environment and health. No additional grey literature searches were conducted.

Table 1 Overview of the index terms of the concepts specific for EMBASE, PUBMED, Scopus and PsychInfo

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Concepts* | EMBASE | PUBMED | SCOPUS | PSYCH INFO |
| HEALTH | Public health | Environmental medicinePublic health surveillanceSocial determinants of health |  | Public health |
|  | Mental health |  | Mental health |
|  | Minority health | Minority health |  | Health disparities |
|  | Urban health | Population health  | Population health | Urban health |
|  | Rural health |  | Rural health |
|  | Population health |  | Population health |
|  | Well-being  | Well-being |  | Well-being |
|  | Health equity | Health equity |  | Health disparities |
|  | Health status | Vital statistics | Health status | Health status |
|  | Mortality  |  | Epidemiology Health outcomes |
|  | Morbidity |  |
|  | Incidence |  |
|  | Prevalence |  |
|  | Epidemiological surveillance | Epidemiological monitoringCausality |  |
|  | Disease burden | Global burden of disease |  |
|  | Motor activity | Motor activity |  |  |
|  | Healthy lifestyle | Healthy lifestyle |  | LifestyleHealth behaviour |
|  | Health behaviour  | Health risk behaviours |  |
|  | Pathogen transmission | Disease transmission, infectiousZoonoses |  | Infectious disordersDisease transmission |
|  | Zoonotic transmission |  |
|  | Infection risk  |  |
| SOCIAL NEIGHBOURHOOD ENVIRONMENT | Neighbourhood  | Residence characteristics | Neighbourhood  | NeighbourhoodsFacilities  |
|  | Social cohesion |  |  |  |
|  | Social capital  | Social capital  |  | Social capital  |
| PHYSICAL ENVIRONMENT | Physical environment |  | Built environment Blue space | Built environmentBlue space |
|  |  |  |  | Environmental attitudes |
|  | Environmental planning  | Social planning Environment design | Environment design | Environmental planning |
|  | Environmental quality  |  |  |  |
|  | Environmental management  | Environmental policy |  | Environmental policy |
|  | City planning |  |  | Urban planningUrban environments |
|  | Pollution AND pollution related phenomena  | Environmental pollution |  |  |
|  | Environmental exposure |  |  | Environmental effectsExposure |
|  | Recreational park  | Parks, recreational  |  | Recreation areas  |
|  | Vegetation |  | Green space  | Nature (environment)  |
|  | Land use |  |  |  |
|  | Dens\* NEAR/2 urban |  | Urban densification  | CrowdingOverpopulation |
|  | Urbanization  | Urbanization |  | Urbanization |

1. **Eligibility criteria**

First, articles were included based on the following eligibility criteria:

* In-press or published in English, Dutch or German which are the professional languages of the reviewers.
* Published after 2015 in a peer-reviewed journal to obtain state of the art articles.
* Primary research only.

Second, articles with an explicit reference to the physical and/or natural living environment as well as human health and/or well-being were screened based on the following exclusion criteria:

* No specific link to (a feature of) the living environment
* No specific link to a health outcome
* Not translatable to Dutch context (e.g. excluding slums, non-endemic infectious diseases)
* Indoor housing environment/quality
* Animal studies
* Studies which only cover the individual social environment (e.g., social support or peer-pressure)
* Studies on the social environment without a specific link to the physical living environment (e.g. social networks)
* No access to full-text of the article
* Study types i.e. protocols, methodological evaluations, commentary, editorial, reviews
* Settings i.e. work environment, situation for homeless people, socio-economic environment

**9. Data management and selection**

The review management program Covidence was used for the article screening. Title-abstract and full-text screening were conducted independently by two researchers. Articles which did not conform to the eligibility criteria were excluded during the title-abstract screening. The remaining articles were screened for full-text and again reviewed based on the eligibility criteria. Articles categorized as “maybe”, were discussed by the two researchers in order to come to an agreement.

Moreover, the option in Covidence to label articles with self-defined key topics was used during screening. The list of key topics (figure 1) has been created by the two researchers based on previous research and conceptual frameworks about the relations between the living environment and health.

Subsequently, text-mining in the programming language R (version 4.2.0) was used to retrieve data from elements/characteristic of the living environment, health outcomes, as well as study design and population. A file that lists all the included studies after full-text screening was exported from Covidence. The file consisted of columns that describe the title of the article, the publication year, the abstract and the labelled key topics. We manually created lists with terms of health outcomes and elements of the living environment named in the abstracts. These lists enabled a simple form of text mining from the abstracts. In general, text mining detects specific search terms from a set of data. Since we aimed to perform a broad scoping review without a specifically defined outcome, we needed to manually identify all health outcomes and elements of the living environment mentioned in the abstracts. By using text mining, the terms of these lists are recognized and summarized in a separate column per article.

For extensive and more detailed data extraction, a data charting form was created in Covidence (table 2). The data charting form was independently evaluated by the two reviewers. This form was used to extract data from a number of studies on each topic to check whether the extracted data aligns to the purpose of the scoping review (42). The predefined data form included:

Table 2 Structure and information extracted from the data charting form

|  |  |
| --- | --- |
| General information  | Environmental labels, health labels, title, year of publication, country, geographical region, aim of study  |
| Methodology  | Qualitative/quantitative/mixed methods, study design, description of the study design, study population, description/details of the study population, sample size, natural and built element(s) in the living environment / intervention(s), characteristics / details / dimensions or detailed information of physical element or intervention, indirect health outcome (behaviour/exposure), direct health outcome, data collection, description of data collection, analytical method(s), description of analytical method, statistical analysis, description of statistical analysis  |
| Results  | Independent variable, Dependent variable, Effect modifier, Effect mediator, Confounder, Positive/negative effect, Behaviour/exposure, Health outcome, Outcome value, Outcome measure (e.g. hazard ratio, odds ratio), Confounder/effect modifier, Positive / negative / non-significant association |
| Discussion and conclusion  | Key findings and conclusion, policy recommendation(s), positive/negative quality notes  |

 **10. Data synthesis and presentation**

Data synthesis was performed in the programming software R (version 4.2.0) based on the data extraction output. The proportion and intersection of studied key topics to investigate their interrelation were plotted. Moreover, (i.e. the number and characteristics of) the investigated associations between the living environment and health were mapped to identify knowledge gaps and give directions for future research. Especially articles that covered the combination of several living environment labels were of interest. Moreover, the type of study designs (e.g. cross-sectional, longitudinal, natural experiment) and study populations (e.g. elderly, children, migrants) were inspected. By means of evidence gap maps, upset plots and other descriptive illustrations the study findings were presented.

**Appendix**

**Description of the labelled key topics**

|  |  |  |  |
| --- | --- | --- | --- |
| **Key topic**  | **Living environment label** | **Description**  | **References** |
| **Environmental stressor** | **Air quality** | Environmental stressors are natural or anthropogenic factors that can induce health impacts. Examples of environmental stressors are air pollution, noise pollution, light pollution, temperature, allergens, and infectious agents.  | (43, 44) |
| **Allergy**  |
| **Climate** |
| **Environmental quality** |
| **Hazard exposure** |
| **Infectious diseases** |
| **Light** |
| **Noise** |
| **Access to facilities / amenities** | **Access to facilities / amenities** | Accessibility encompasses the number, variety and types of facilities and amenities. Facilities and amenities entail (basic) public services, by means of, for example, good infrastructure or high density of facilities.  | (45) |
| **Healthcare** |
| **Alcohol / tobacco / drugs** | **Alcohol / tobacco / drugs** | The density of tobacco or alcohol outlet shops, smoking bans or built environmental features such as ash trays can influence the use of alcohol/tobacco/drugs.  | (46) |
| **Biodiversity** | **Biodiversity** | Biodiversity is shaped by the landscape that surrounds or is embedded in the living environment. Biodiversity has been described by the WHO as “the variability of – and among – living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. It includes diversity within species, between species and of ecosystems.”  | (47-49) |
| **Blue spaces**  | **Blue spaces** | Outdoor blue spaces combine surface waterbodies, such as rivers, lakes and fountains, and coastal regions, such as beaches, the sea and promenades.  | (9, 10, 50) |
| **Environmental perception** | **Environmental perception** | Awareness of or feelings about, the objective characteristics of the environment, and apprehending the environment by the senses, including personal and contextual aspects. | (25, 51) |
| **Food environment** | **Food environment** | The food environment (food stores and restaurants) can be described by four dimensions: food availability, affordability, accessibility and acceptability.  | (52-54) |
| **Green space** | **Green space** | Vegetated land that is public or semi-private. In urban areas green spaces are for examples parks, sports fields, cemeteries, vegetated areas of street and road corridors, natural and built corridors adjacent to waterways and [wetlands](https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/wetlands), and external green areas to public buildings (e.g. libraries, galleries, community centres).  |  |
| **Healthy mobility** | **Healthy mobility** | Environmentally friendly and healthy modes of transport, such as cycling or walking (active transport). Active travel also entails access to public transport, and mobility infrastructure promoting healthy mobility. | (12, 55) |
| **Neighbourhood condition** | **Housing infrastructure /****gentrification** | A measure of environmental quality of the neighbourhood. This can include disadvantagesor deprivation (resources, crime), regeneration, housing renewal and infrastructure and gentrification. | (56-58) |
| **Housing renewal** |
| **Neighbourhood deprivation** |
| **Neighbourhood intervention** |
| **Regeneration** |
| **Land use mix** | **Land use mix** | The combination or integration of different natural and built elements in the living environment. These offer more than one function and can for instance include different walking destinations in a neighbourhood, as it is associated with access to different facilities, amenities and public open spaces.  | (59, 60) |
| **Social environment** | **Social environment** | Social environmental aspects at neighbourhood level include social cohesion, (community), social capital as well as social safety. This entails social contact between community members, social integration and ties that can benefit individual’s health.  | (61-64) |
| **Social cohesion** |
| **(Community) Social capital** |
| **(Social) Safety** |
| **Sport and Play**  | **Sport and Play** | Features or aspects in the living environment that promote or facilitate intended physical activity; physical activity as part of recreation and leisure (i.e. play, games, sports or planned exercise). | (65, 66) |
| **Urban densification**  | **Urban densification**  | The process of growing density or state of a compact and high density city. Urban environment with high population and dwelling density, closer proximity to facilities and amenities (i.e. urbanicity, urban form). | (67, 68) |

**Full search queries**

1. Embase

('public health'/exp/mj OR 'mental health'/exp/mj OR 'minority health'/exp/mj OR 'urban health'/exp/mj OR 'rural health'/exp/mj OR 'population health'/exp/mj OR 'wellbeing'/exp/mj OR 'health equity'/exp/mj OR 'health status'/exp/mj OR 'mortality'/exp/mj OR 'morbidity'/exp/mj OR 'incidence'/exp/mj OR 'prevalence'/exp/mj OR 'epidemiological surveillance'/exp/mj OR 'disease burden'/exp/mj OR 'motor activity'/exp/mj OR 'healthy lifestyle'/exp/mj OR 'health behavior'/exp/mj OR 'pathogen transmission'/exp/mj OR 'zoonotic transmission'/exp/mj OR 'infection risk'/exp/mj) AND ('neighborhood'/exp/mj OR 'social cohesion'/exp/mj OR 'social capital'/exp/mj OR 'neighbo\*rhood effects':ti OR 'physical environment' OR 'landscape environment':ti OR 'perceived environment':ti OR 'outdoor environment':ti OR 'built environment':ti OR 'natural environment':ti OR 'greenspace':ti OR 'greenery':ti OR 'greenness':ti OR 'blue space':ti OR 'environmental planning'/exp/mj OR 'environmental quality' OR 'environmental management'/exp/mj OR 'city planning'/exp/mj OR ('pollution'/exp/mj AND 'pollution related phenomena') OR 'environmental exposure'/exp/mj OR 'recreational park'/exp/mj OR 'vegetation'/exp/mj OR 'land use'/exp/mj OR ('dens\*' NEAR/2 'urban') OR 'urbanicity':ti OR 'urbanization'/exp/mj) AND [2016-2021]/py AND (english:la OR german:la OR dutch:la) AND ('article'/it OR 'article in press'/it OR 'review'/it)

1. Pubmed

("environmental medicine"[MeSH Major Topic] OR "public health surveillance"[MeSH Major Topic] OR "social determinants of health"[MeSH Major Topic] OR "population health"[MeSH Major Topic] OR "wellbeing"[Title] OR "minority health"[MeSH Major Topic] OR "health equity"[MeSH Major Topic] OR "vital statistics"[MeSH Major Topic] OR "epidemiological monitoring"[MeSH Major Topic] OR "causality"[MeSH Major Topic] OR "global burden of disease"[MeSH Major Topic] OR "motor activity"[MeSH Major Topic] OR "healthy lifestyle"[MeSH Major Topic] OR "health risk behaviors"[MeSH Major Topic] OR "zoonoses"[MeSH Major Topic] OR "disease transmission, infectious"[MeSH Major Topic]) AND ("neighborhood"[Title] OR "residence characteristics"[MeSH Major Topic] OR "social capital"[MeSH Major Topic] OR "social cohesion"[Title] OR "physical environment"[Title] OR "perceived environment"[Title] OR "outdoor environment"[Title] OR "built environment"[Title] OR "natural environment"[Title] OR "greenery"[Title] OR "green space"[Title] OR "blue spaces"[Title] OR "greenspace"[Title] OR "greenness"[Title] OR "blue space"[Title] OR "social planning"[MeSH Major Topic] OR "environmental quality"[Title] OR "environment design"[MeSH Major Topic] OR "environmental policy"[MeSH Major Topic] OR "environmental pollution"[MeSH Major Topic] OR "parks, recreational"[MeSH Major Topic] OR "vegetation"[Title] OR "land use"[Title] OR "urban density"[Title] OR "urban stressors"[Title] OR "urbanization"[MeSH Major Topic]) AND 2016/01/01:3000/12/31[Date - Publication] AND ("english"[Language] OR "dutch"[Language] OR "german"[Language])

1. Scopus

( TITLE-ABS-KEY ( ( "population health" OR "health status" ) ) AND TITLE-ABS-KEY ( ( "neighborhood" OR "built environment" OR "green space" OR "blue space" OR "environment design" OR "urban densification" ) ) AND LANGUAGE ( ( "English" OR "Dutch" OR "German" ) ) ) AND PUBYEAR > 2015 AND PUBYEAR < 2022 AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "re" ) )

1. PsychInfo

(exp Public Health/ OR exp Mental Health/ OR exp Urban Health/ OR exp Rural Health/ OR exp Population Health/ OR well being/ OR exp Health Status/ OR exp Health Disparities/ OR exp Epidemiology/ OR exp Health Outcomes/ OR exp Lifestyle/ OR exp Health Behavior/ OR exp Disease Transmission/) AND (exp Neighborhoods/ OR exp Social Capital/ OR exp Facilities/ OR exp Environmental Attitudes/ OR exp Built Environment/ OR "nature (environment)"/ OR green space.m\_titl. OR blue space.m\_titl. OR exp Urban Planning/ OR exp Environmental Planning/ OR urban environments/ OR environmental effects/ OR pollution/ OR exp Recreation Areas/ OR population density.mp. OR crowding/ OR exp Overpopulation/ OR urbanization/ OR exp Social Density/)
AND (limit to (full text and yr="2016 - 2021"))

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