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A Review of Studies on Climate Change and Social Variables from the Perspective of Social

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ABSTRACT

Introduction: Many studies have illustrated climate change effects on social variables and health. This study aimed to identify the SDH associated with climate change.

Methods: The present study is a review study with a systematic search. The keywords related to climate change and social variables were searched in the Web of Science and PubMed databases until June 2018. In the initial search 12097 articles were obtained and after the elimination of duplicate and non-related articles, 5932 articles remained After studying the abstracts, 342 articles were excluded based on entry and exit criteria (studies that were not related to climate change and SDH) and 43 articles remained. In the next phase, the full text of the articles was evaluated by two evaluators individually and the consensus method was used. 23 papers were finally included in the study.

Results: According to the review, social variables related to climate change were divided into 5 different categories of variables, including structural variables related to climate change (socioeconomic status), variables related to social status and work conditions (access to health services, unemployment, immigration, inequality, education, work condition, food security), variables related to social relationships and social networks (social movements, urban warfare, riot, group protests, interpersonal violence), individual variables related to lifestyle (place of living; city/village), and individual variables (age, race, gender) based on social determinants of health.

Conclusion: Climate change has a wide range of social outcomes.. Various groups that are vulnerable to climate change include women, elderlies, children, villagers, and workers.

Keywords: Climate change, Health, Social determinants of health

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Introduction

Climate is referred to as the average patterns of meteorological elements such as temperature, humidity, etc according to seasonal and temporal conditions (1). According to the UNFCCC (United Nations Framework Convention on Climate Change) definition, climate change is referred to as any change in the climate that has been directly or indirectly made by human activity or naturally (2, 3). As reported by the Intergovernmental Panel on Climate Change (IPCC), the temperature of earth, sea levels, and greenhouse gas emissions have increased significantly between 1980 and 2000 (4). The average temperature of earth has increased between 1.4° and 5.8° C in the current century (5), and IPCC reports the occurrence of climate events such as heatwave, flood, and drought will increase in the current century (6). Global climate change has become a major challenge for human societies. On the other hand, changes in the quality of climate and the ecology will have implications for human health (7). Epidemiological evidence suggests that climate change and health are interconnected (8). World Health Organization (WHO) estimates, in 2012, 12.6 million deaths (23% of the world's total mortality) were related to environmental factors, many of which were affected by climate change (9).

The social determinants of health (SDH) are the economic and social conditions that influence individual and group differences in health status (10). Many studies indicate climate change affects social variables and health through social determinants of health (SDHs) (11-15). These social variables determine vulnerability towards climate change (9). Therefore, even if we are not able to control climate change, we need to reduce the vulnerability of societies towards it. Vulnerability refers to the degree of danger and inability of geophysical, biological, and socio-economic systems in overcoming the negative effects of climate change (16).

Bjarnadottir et al. (2011) have examined the vulnerability to climate change based on demographic characteristics of populations. The result showed that age and gender play a role in vulnerability to climate change so that older people and women are more vulnerable (17). Another study by Cattaneo et al. (2016) have found that place of residence influences the vulnerability. Based on the result of this study, living in rural or marginalized areas affects the severity of climate change impact and increases its severity (18). Furthermore, reduction in farmland, horticultural, and livestock production can reduce the income of farmers and workers of these sectors, reduce permanent and seasonal migration, and increase food price and unemployment. (19). Although hot temperatures increase aggression by directly increasing feelings of hostility and indirectly increasing aggressive thoughts. Results of Anderson et al (2020) show that global warming trends may well increase violent-crime rates (20). Another review study by Karki et al (2020) found that farmers worldwide have been experiencing changes in climate mainly regarding rising temperatures, unpredictable and reduced rainfall (21).

Many social variables seem to be related to climate change (22). This study, by identifying social variables influenced by climate change, will be beneficial for policymakers to identify vulnerable groups and social risks of climate change in the future, given the country's susceptibility to climate change. So, this study aimed to identify the SDH associated with climate change using a review method.

Methods

This is a review study with a systematic search. After conducting a regular search through databases, the potential articles were evaluated and screened, and those that had the entry criteria were included in the final study. Search for articles was conducted in June 2018. For the regular search, first, the keywords related to climate change and social variables were searched in the Web of Science and PubMed databases. In each database, a search strategy specific to that database was used with the use of OR, AND

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operators. The following table shows the search strategy in each database.

Also, the list of English articles was saved in Endnote software so that, duplicates could easily be deleted. Table 2 shows the inclusion and exclusion criteria.

Table 1. The search strategy

Database	Search strategy
PubMed	((‘climate change’ [Title/Abstract] OR ‘global warming’ [Title/Abstract] OR ‘climate variability’ [Title/Abstract] OR ‘greenhouse effect’ [Title/Abstract] OR ‘GHGE’ [Title/Abstract])) AND ((((‘social’ [MeSH Terms] OR ‘social’ [Title/Abstract]) OR (‘social determinant of health’ [MeSH Terms] OR ‘social determinant of health’ [Title/Abstract]) OR (‘SDH’ [MeSH Terms] OR ‘SDH’ [Title/Abstract]) OR (‘racism’ [Title/Abstract]) OR (‘race’ [Title/Abstract]) OR (‘sex’ [Title/Abstract]) OR (‘Lifestyle’ [Title/Abstract]) OR (‘gender’ [Title/Abstract]) OR (‘Age’ [Title/Abstract]) OR (‘Lifestyle’ [Title/Abstract]) OR (‘Occupation*’ [Title/Abstract]) OR (‘employment’ [MeSH Terms] OR ‘employment’ [Title/Abstract]) OR (‘demographic’ [Title/Abstract]) OR (‘Unemployment’ [Title/Abstract]) OR (‘Socio-economic’ [Title/Abstract]) OR (‘SEC’ [Title/Abstract]) OR (‘migration’ [Title/Abstract]) OR (‘education’ [Title/Abstract]) OR (‘crime’ [Title/Abstract]) OR (‘diet’ [Title/Abstract]) OR (‘behavior’ [Title/Abstract]) OR (‘Social networks’ [Title/Abstract]) OR (‘business’ [Title/Abstract]) OR (‘housing’ [Title/Abstract]) OR (‘social movement’ [Title/Abstract]) OR (‘Violence’ [Title/Abstract]) OR (‘income’ [Title/Abstract]) OR (‘Population changes’ [Title/Abstract]) OR (‘exercise’ [Title/Abstract]) OR (‘Alcohol’ [Title/Abstract]) OR (‘drugs’ [Title/Abstract]) OR (‘GDP’ [Title/Abstract]) OR (‘productivity’ [Title/Abstract]) OR (‘civil conflict’ [Title/Abstract]) OR (‘welfare’ [Title/Abstract]) OR (‘wellbeing’ [Title/Abstract]) OR (‘vulnerability’ [Title/Abstract]))
Web of science	TI=((‘climate change’ OR ‘global warming’ OR ‘climate variability’ OR ‘greenhouse effect’ OR ‘GHGE’)) AND TI= (‘social’ OR ‘social determinant of health’ OR ‘SDH’ OR ‘racism’ OR ‘race’ OR ‘sex’ OR ‘Lifestyle’ OR ‘gender’ OR ‘Age’ OR ‘Lifestyle’ OR ‘Occupation*’ OR ‘employment’ OR ‘demographic’ OR ‘Unemployment’ OR ‘Socio-economic’ OR ‘SEC’ OR ‘migration’ OR ‘education’ OR ‘crime’ OR ‘diet’ OR ‘behavior’ OR ‘Social networks’ OR ‘business’ OR ‘housing’ OR ‘social movement’ OR ‘Violence’ OR ‘income’ OR ‘Population changes’ OR ‘exercise’ OR ‘Alcohol’ OR ‘drugs’ OR ‘GDP’ OR ‘productivity’ OR ‘civil conflict’ OR ‘welfare’ OR ‘wellbeing’ OR ‘vulnerability’))

Table 2 The inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
- Articles that examined the association of at least one of the climate change variables with social determinants. - Qualitative and quantitative studies that have sued scientific methods.	- Articles related to non-human species (birds, fish, etc)

The Prisma protocol was used to screen and evaluate the articles. In the initial search using the keywords, 12097 articles were obtained and after the elimination of duplicate and non-related articles, 5932 articles remained. The cases of letter to the editor were also excluded from the study. After studying the abstracts, 342 articles were excluded based on entry and exit criteria (studies that were not related to climate change and SDH) and 43 articles remained. In the next phase, the full text of the articles was evaluated by two evaluators individually. If consensus was not reached, the consensus method was used.

Based on the reviews, 23 papers were finally included in the study (Figure 1).

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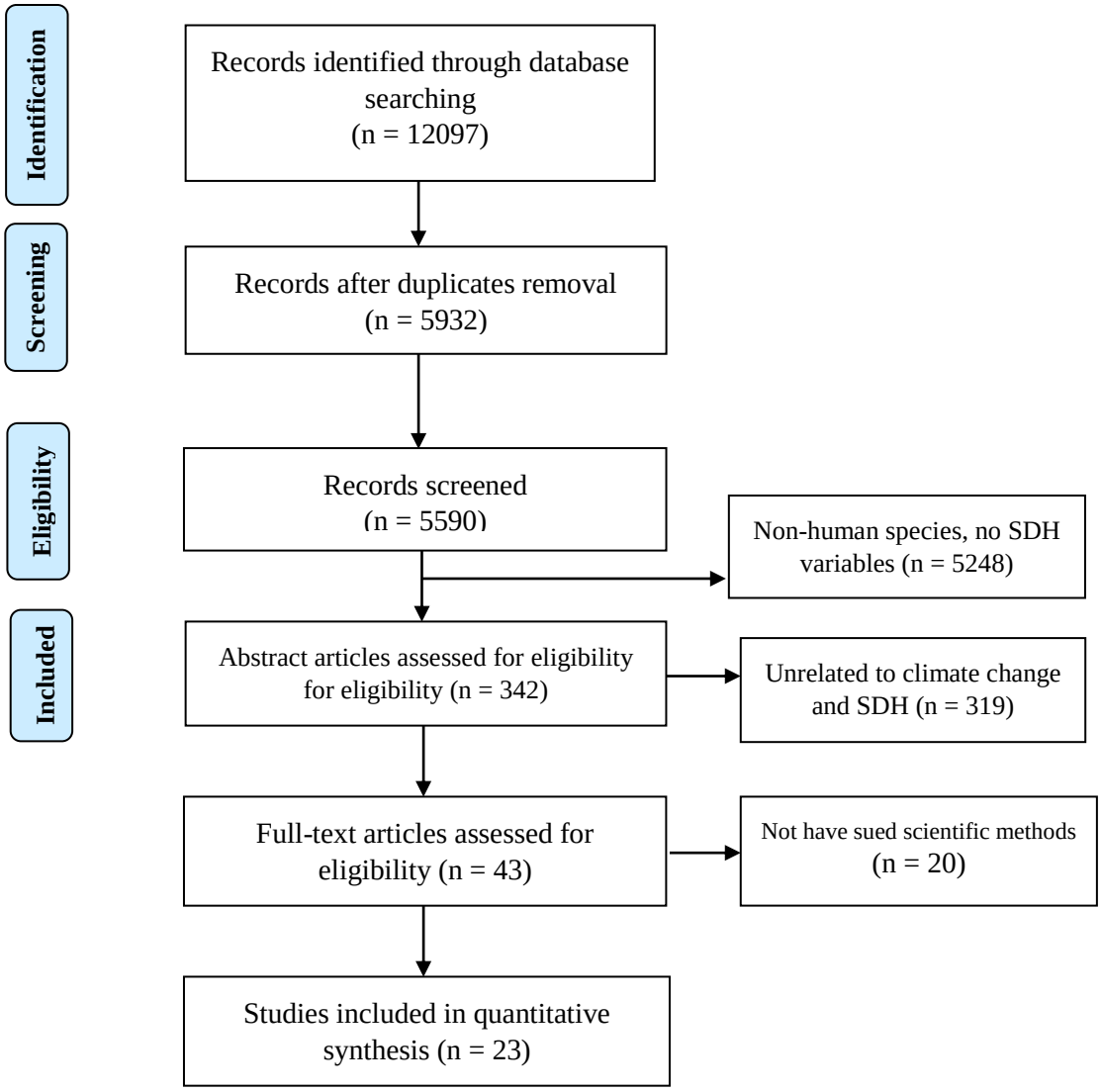

Figure 1. Articles identified in the stages of screening, quality assessment, and entry in the study

It should be noted that the intention was not to carry out a systematic review at this stage, but to use a systematic search, so the screening stages were carried out systematically according to the criteria of the research team. Finally, the articles most closely related to the subject of the study were reviewed.

Results

The present study reviewed 23 articles. According to the findings of this study, temperature and precipitation are among the climate variables, and any changes in them result in behavior changes. Evidence suggests that personal violence can be increased at high temperatures and low rainfall conditions (23, 24) to the extent that, the rate of rape changes with changing climatic variables. Evidence shows that at high temperatures, the reported incidence of rape increases (25). Increasing temperature and decreasing rainfall are associated with anti-social behavior against service workers, corruption in social media, and crime and violence such as murder, retaliation, theft, and attack (26), which take place in poorer and more rural areas with more agricultural context (27). In addition to personal violence, group violence is also associated with climatic variables. Warmer weather conditions have increased the protests and violence of rebels in India (28), urban wars in

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Somalia (29), and invasions in Brazil (28). The riots may happen to protest against the government's policies towards increasing climate change. Inter-sectoral interactions are also affected by climate change. Institutional failures and the collapse of governments are linked to climate change. Social movements are also being formed to deal with climate change, which makes changes at the economic, social, and political levels.

There are also a number of faulty cycles that interconnect the impacts of climate change and exacerbate its effects. Bad economic conditions cause the villagers to migrate to cities (18), and on the other hand, the urbanization and expansion of cities accelerate climate change (30, 31) and its consequences.

Climate change has different effects on different population groups. Studies have shown that gender and place of residence can create different vulnerabilities toward climate change. Based on available evidence, women and the poor are more vulnerable to climate change. Women are more exposed to environmental hazards; for example in some areas, cooking and collection of food is the responsibility of women. Furthermore, women pay more attention to family members and relatives and less to themselves due to their sense of responsibility in providing services, so they are more exposed to the dangers of climate change and incidents. On the other hand, evidence has shown that women's dressing in some cultures makes them more vulnerable to climate change (32). Living in rural areas has a major effect on vulnerability towards climate change as they are highly dependent on agricultural and livestock production, which can be directly affected by climate change. Residents of rural areas are faced with a lack of job and food insecurity caused by reducing agricultural production due to climate change (agricultural water and precipitation shortages), and this causes them to migrate to urban and industrial areas (33).

The effects of climate change on health and social determinants of health cannot be dismissed. Social determinants of health broadly show the ways that climate change influences health. For example, climate change affects health through agriculture, food production, education, work condition, number of workers, hours of work, unemployment, access to water, health services, and housing.

Climate change affects the vulnerability of some groups just like storms. For example, climate change has a significant impact on Coastal Community Social Vulnerability Index (CCSVI), which includes race, gender, age, and economic and social status (17). Evidence suggests that social and economic inequalities have a significant impact on access to health services and air conditioning systems, and other variables that increase vulnerability. For example, a study conducted in the United States has shown that black people are less likely to use a conditioning system than whites (34).

Many studies have revealed the impact of climate change on social variables. These variables can affect vulnerability or exposure to climate change by affecting health outcomes.

Table 3 shows that the list of SDH variables could be affected by climatic variables that are obtained in this review study. Climate change affects health through social determinants of health. It also plays a role in exposure or vulnerability through social determinants of health. These social variables can be divided into the following groups based on the conceptual framework of social determinants of health provided by the Commission of Social Factors Affecting Health. Figures 2 shows this division.

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Table 3. SDH variables could be affected by climatic variables

No	Source	Year	Method	Social Variables Related To Climate Change
1	Sandesh Adhikari 2017	2017	Review study	Education
2	Sandesh Adhikari 2017	2017	Review study	Access to food
3	Sandesh Adhikari 2017	2017	Review study	Access to health services
4	Cattaneo 2016	2016	Cross-sectional study	Migration
5	Carrillo PE 2015	2015	Longitudinal study	Gender
6	Baylis P 2015	2015	Cross-sectional study	Corruption in social media
7	Jessoe K 2014	2014	Panel data analysis	Unemployment
8	Diao X 2014	2014	Cross-sectional study	Urban warfare
9	Jessoe K 2014	2014	Panel data analysis	work condition
10	Jessoe K 2014	2014	Panel data analysis	Place of residence (city / village)
11	Ranson M 2014	2014	Panel data analysis	Theft
12	Ranson M 2014	2014	Panel data analysis	Crime
13	Hsiang SM 2013	2013	Systematic review	Personal violence
14	Blakeslee D 2013	2013	Longitudinal study	Revenge/ retaliation
15	Blakeslee D 2013	2013	Longitudinal study	Murder
16	Kolb P, Gockel C	2012	Experimental study	Anti-social behavior against service workers
17	Bjarnadottir S 2011	2011	Longitudinal study	Age
18	Bjarnadottir S 2011	2011	Longitudinal study	Race
19	Bjarnadottir S 2011	2011	Longitudinal study	Socioeconomic status
20	Hidalgo FD 2010	2010	Review study	Social movement
21	Hidalgo FD 2010	2010	Review study	Riots
22	Hidalgo FD 2010	2010	Review study	Group protests
23	Kenrick DT	1986	Cross-sectional study	Rape

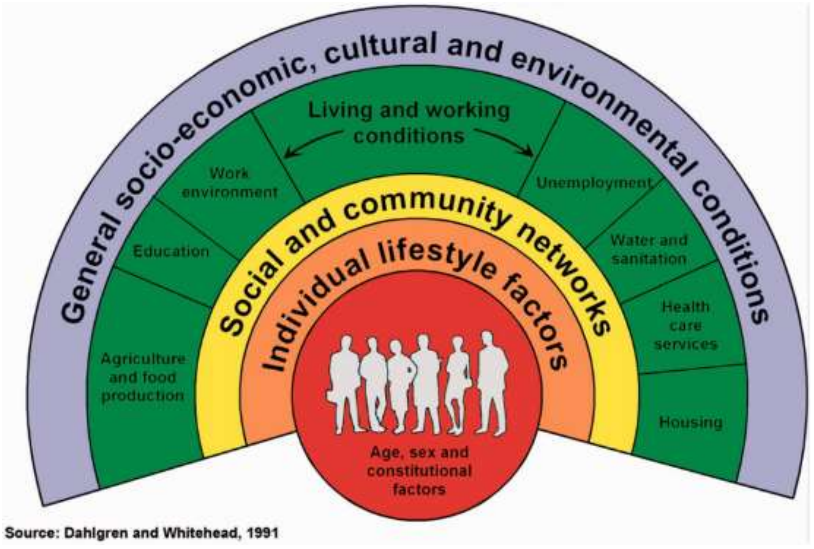

Figure 2, A. level of SDH variables

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Figure 2, B. Division of social variables related to climate change based on impact levels

Discussion

Climate change in the reviewed studies referred to changes in temperature, precipitation, humidity, and various phenomena such as floods and droughts that affect social variables at different levels of vulnerability in some groups. According to the results of the present study, the social variables associated with climate change include:

- Structural variables related to climate change (socioeconomic status)
- Variables related to social status and work condition (access to health services, unemployment, immigration, inequality, education, work condition, food security)
- Variables related to social relationships and social networks (social movements, urban warfare, riot, group protests, interpersonal violence)
- Individual variables related to lifestyle (place of living; city/village)
- Individual variables (age, race, gender)

Based on the review studies, it can be concluded that climate change has a wide range of SDH outcomes. As studies that indicate climate change affects social variables and health through social determinants of health (SDHs), the present study showed a relationship between climate change and SDH (11-15).

In line with the present study, previous studies have concluded similar results and showed that violent behavior increases with increasing temperature (20). On the other hand, in line with Carlton et al (2016), the result shows demographic characteristics such as age, gender, and race are effective invulnerability towards climate change by influencing the health outcomes (35). Burke et al (2015) examined the theft and crime, like this study, and found that deviations from moderate temperatures and precipitation patterns systematically increase conflict risk (36).

The present study in line with a review study by Karki et al (2020), has shown that farmers and villagers are more vulnerable to climate change, and rural-to-city migration increases by increasing climate change (21). This study showed that age and gender play a role in vulnerability to climate change so that older people and women are more vulnerable which is in line with Bjarnadottir et al. (2011) study (17). Furthermore, this study concludes place of residence influences the

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vulnerability of climate change. The result in line with Cattaneo et al (2016) study, shows living in rural or marginalized areas affects the severity of climate change impact and increases its severity (18).

Since most studies have not reported their results quantitatively, in this study, the quantitative report on the relationship between climate change and SDH outcomes had several limitations in some cases. There was no meta-analysis heterogeneity of the statistics in the review articles. There were also no critical appraisal tools available due to assessing the qualities of articles because this study is a kind of narrative review article but systematic search was used. Future research should focus on quantifying climate change impacts on specific areas with attention to the most vulnerable groups and the variation within these groups. Increased understanding of the drivers and destinations of migration will become ever more important for future planning in cities and rural areas.

Conclusion

Based on the review of studies, it can be concluded that climate change has a wide range of social outcomes. On the other hand, environmental conditions have a significant impact on the social, mental, and physical health of people, and the climate and its change can be an effective determinant of health. Different groups have also a different vulnerability towards climate change, so that women, elderlies, children, villagers, and workers are more vulnerable to climate change. The paper has a noble idea and discussed the two important global issues that are social determinants of health and climate change. By identifying the social consequences of climate change, policies that facilitate adaption to this phenomenon or reduce its consequences can be made. At the current time, future social harms can be prevented by identifying the vulnerable groups, and supporting and empowering them.

Identifying the levels of climate change impact will help policymakers to precisely plan interventions to control or adapt to climate change

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Author Contribution

G.B conceived of the presented idea and H.S. and M.N verified the systematic search. H.S and A.S supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Conflict of interest

There is no conflict of interest.

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