Intersectoral collaboration in the management of non-communicable disease’s risk factors in Iran: stakeholders and social network analysis

Ahad Bakhtiari1, Amirhossein Takian1,2,3*, Reza Majdzadeh4, Afshin Ostovar5, Mehdi Afkar6 and Narges Rostamigooran7

Abstract

Introduction: As the major cause of premature death worldwide, noncommunicable diseases (NCDs) are complex and multidimensional, prevention and control of which need global, national, local, and multisectoral collaboration. Governmental stakeholder analysis and social network analysis (SNA) are among the recognized techniques to understand and improve collaboration. Through stakeholder analysis, social network analysis, and identifying the leverage points, we investigated the intersectoral collaboration (ISC) in preventing and controlling NCDs-related risk factors in Iran.

Methods: This is a mixed-methods study based on semi-structured interviews and reviewing of the legal documents and acts to identify and assess the interest, position, and power of collective decision-making centers on NCDs, followed by the social network analysis of related councils and the risk factors of NCDs. We used Gephi software version 0.9.2 to facilitate SNA. We determined the supreme councils’ interest, position, power, and influence on NCDs and related risk factors. The Intervention Level Framework (ILF) and expert opinion were utilized to identify interventions to enhance inter-sectoral collaboration.

Results: We identified 113 national collective decision-making centers. Five councils had the highest evaluation score for the four criteria (Interest, Position, Power, and Influence), including the Supreme Council for Health and Food Security (SCHFS), Supreme Council for Standards (SCS), Supreme Council for Environmental Protection (SCIP), Supreme Council for Health Insurance (SCHI) and Supreme Council of the Centers of Excellence for Medical Sciences. We calculated degree, in degree, out-degree, weighted out-degree, closeness centrality, betweenness centrality, and Eigenvector centrality for all councils. Supreme Council for Standards and SCHFS have the highest betweenness centrality, showing Node’s higher importance in information flow. Interventions to facilitate inter-sectoral collaboration were identified and reported based on Intervention Level Framework’s five levels (ILF).

Conclusion: A variety of stakeholders influences the risk factors of non-communicable diseases. Through an investigation of stakeholders and their social networks, we determined the primary actors for each risk factor. Through the...
Background
NCDs have been identified as the leading cause of Years of Life Lost (YLL), Disability-Adjusted Life Years (DALYs), and mortality in countries by controlling communicable diseases, changing lifestyles, and growing risk factors for NCDs such as air pollution, low physical activity, and unhealthy nutrition. The share of NCDs from total deaths, both sexes, all ages increased between 1990 and 2019 in Iran (50.11% to 83.48%), the world (57.72% to 74.37%); a similar trend has occurred in the share of NCDs from total DALYs, Iran (45.33% to 78.09%), the world (43.19% to 63.82%); the global economic burden of NCDs is predicted to be USD47 trillion between 2010 and 2030 [1–4]. According to the Global Burden of Disease (GBD) 2019, about 16.5%, 4.5%, 18.8%, 30.6%, and 14.1% of all deaths in Iran in 2019 were attributable to dietary risk factors, insufficient physical activity (IPA), high BMI, high systolic blood pressure, and tobacco use respectively. The Iran STEPs 2016 survey revealed a high prevalence of IPA, approximately 54.7% of the total population, as defined by WHO recommendation, which is less than 600 Metabolic Equivalent of Task (MET) per week, and 9.6% of participants were current cigarette smokers, the majority of whom were aged 45–70 [5, 6]. Between 2011 and 2025, monetary losses to the low and middle-income countries (LMICs) that emerged from four main NCDs are predicted to exceed US$ 7 trillion, 70% of which will occur in the upper-middle-income countries (UMICs) [7]. It has been determined that 51% of this yearly loss will be linked to cardiovascular disease, equal to around 4% of these countries’ current annual output [7]. Let alone that the COVID-19 pandemic might exacerbate NCDs’ burden due to possible ignorance of NCDs’ priority [8].

NCDs’ prevention and control need global, national, multi-sectoral, and multistakeholder engagement. As a key strategy to achieve health systems’ goals and reduce health inequities, inter-sectoral collaboration is recommended by the “Global Action Plan” of the World Health Organization (WHO) for the prevention and control of NCDs, as well as by the “National Plan for Prevention and Control of NCDs” in Iran [3, 9, 10]. Nevertheless, the status of current inter-sectoral collaboration initiatives in Iran does not appear as meaningful as they are supposed to be for effective management of NCDs [11], e.g., in the field of urban and transport planning [12], food industry [13].

Meaningful prevention and control of NCDs need a comprehensive approach, which brings all sectors on board to work unitedly to reduce the risks associated with NCDs and to prevent and control NCDs’ burden on communities. These include, but are not limited to, health, economics, diplomacy, foreign health policy, education system, agriculture, insurance organizations, markets, tax system, food industry, legislative system, etc. [14–17]. Intersectoral collaboration (ISC) is mentioned in Articles VII and VIII of the Alma Ata Declaration of 1978: “All governments should formulate national policies, strategies, and plans of action to launch, and sustain primary health care as part of a comprehensive national health system and in coordination with other sectors. To this end, it will be necessary to exercise political will, to mobilize the country’s resources, and to use available external resources rationally” [18].

WHO also issued another statement, so-called Intersectoral Action for Health (IAH), which means “a recognized relationship between part or parts of the health sector with parts of another sector which has been formed to take action on an issue to achieve health outcomes (or intermediate health outcomes) in a way that is more effective, efficient or sustainable than could be achieved by the health sector acting alone” [19]. Other global statements, including Primary Health Care (PHC) [20], Millennium Development Goals (MDG) [21], and Sustainable Development Goals (SDGs) also consider ISC as one of the most necessary principles for the health system [22–26].

Stakeholder analysis facilitates the classification of stakeholders, valuing and comparing their particular sets of interests and powers, and examining and reviewing their relationships, including alliances, collaborations, and inherent conflicts [27]. It investigates “who these interested parties are, who has the power to influence what happens, how these parties interact and, based on this information, how they might be able to work more effectively together” [28]. Social network analysis (SNA) is a powerful technique for analyzing the relationship

Keywords: Noncommunicable diseases (NCDs), Risk factors, Supreme councils, Social network analysis (SNA), Intersectoral collaboration (ISC)
among different actors/stakeholders/parts of government and understanding possible ways to improve collaboration towards better outcomes. The insights gained from SNA can help coordinate ISC global and national efforts and interventions for more efficient prevention and control of NCDs [29], i.e., those recommended by the WHO’s PEN (Package of essential NCDs interventions) [9]. Social network theory and SNA help researchers explain the relationship between people, organizations, or even nations, which might enable them to explore the existing connections and draw a more realistic picture of underlying relationships among them [30]. Visualizing ISC as networks can also facilitate stakeholder network analysis techniques and network theories to discover how they can be more effective in tackling NCDs [29, 31].

Embedding collective decision-making mechanisms into the national administrative system is the key to successfully implementing policies in all settings [32]. Iran enjoys several collective decision-making bodies. So-called the “Councils” and the “Supreme Councils” support coordination, policymaking, and planning of joint decisions, taking which requires ISC among various entities, i.e., different ministries in different areas such as health, economy, welfare, the judicial system, and so on [33]. So-called the “cabinet committee”; such a mechanism exists in other countries; a group made up of cabinet ministers, which is formed to enable meaningful actions on a particular issue or general area of importance for the government [34]. Opportunities for ISC between the expert levels are also available in these councils.

The study’s objectives and questions are: What collective decision-making centers exist at the national level to progress IAH and ISC?; Which policies of identified stakeholders influence risk factors?; What interventions (at different levels) can be put on the agenda to control better the policies that have been approved?. Our findings will support, we envisage, national policymaking on NCDs and related risk factors for better knowledge translation and implementing laws and standards in Iran and perhaps similar settings.

Methods
This is a mixed-methods study based on reviewing legal documents and acts and conducting semi-structured interviews to identify and evaluate the interest, position, and power of collective decision-making centers (councils) and their members on NCDs, followed by the Social Network Analysis (SNA). We used Gephi software [35] version 0.9.2 to facilitate SNA. In the final step, based on the Intervention Level Framework (ILF), we identified key leverage points for maximizing the capacity of the identified stakeholders for ISC.

Understanding and identification of NCDs, risk factors of NCDs, and their relationship
To identify major risk factors of NCDs, we used WHO’s 5 × 5 matrix, i.e., five NCDs and five modifiable shared risk factors [5], ‘best buys’ and other recommended interventions for the prevention and control of NCDs [36, 37], the global action plan for the prevention and control of NCDs 2013–2020 [38] plus the GBD tools developed by the “Institute for Health Metrics and Evaluation” (IHME) [39], which includes 359 diseases and injuries and 84 risk factors. We mapped the network among the risk factors and diseases based on the burden of NCDs and related risk factors. Each risk factor’s contribution to shaping the burden (DALY) of NCDs in Iran was obtained from the GBD study of 2017, whose weight and diameter were reflected in the nodes and edges.

Identification of councils and their details
Reviewing of documents
National councils are the place for collective decision-making among relevant ministries and other institutions. We defined the search query to identify the councils. Keywords (Supreme Council or Supreme Councils or Board of Examiner or Crossbreed Councils or Administrative Council or Administrative Councils or Strategic Council or Strategic Councils or Board of Directors or High Representative or Strategic Council or Strategic Councils or Commission or Committee or Headquarters or Workgroup or Board or Council) were searched in the country’s comprehensive law databases (National System of Laws (https://qavanin.ir/Law), parliament system of laws (https://rc.majlis.ir/en); Ministry of Health system of laws (https://healthcode.behdasht.gov.ir/approvals/)), from 1941 until 2020.

Interviews
Semi-structured face-to-face interviews with purposefully selected experts (Appendix B.2) were conducted to properly identify the stakeholders and understand their roles. The interviews, which lasted between 20 and 70 min each, were conducted between August 2020 and December 2020, to ensure data saturation. All interviews occurred at the interviewees’ workplaces. The researchers conducted the interviews using a literature-based and designed interview guide. The following questions were explored during the interviews: Which actors and decision-making institutions are involved in ISC for NCDs’ risk factors? Which dimensions and risk factors are affected by their policies? How do you perceive their responsibilities, abilities, motivations, effects, and interactions? What are your recommendations or
interventions for enhancing ISC? The interviews were transcribed verbatim, and the data were analyzed using a thematic content analysis.

The councils’ statutes, mission, objectives, members, and organization were extracted following their identification. We created a list of each council’s resolutions since its establishment using the databases mentioned and their official website (Table 1).

Each council’s interest, position, power, and influence were valued by reviewing its mission and objectives, members, structure, and resolutions (Table 2).

We used qualitative textual evidence to identify the councils with potential impact on NCDs’ risk factors. These were official public documents [40], to which we had direct or indirect access, and were therefore credible [41]. We considered NCDs and related risk factors as the main framework for searching for relevant councils to sketch a network of NCDs, risk factors, and councils. Based on each council’s documents’ analysis, the council’s potential connection with each risk factor was defined.

### Generating the network and statistical analysis
Following the identification of stakeholders (Supreme Councils and their members), the network’s elements were defined (Table 3) [9, 10, 42–46]. Members of councils, councils, risk factors, NCDs and related SDGs were defined as nodes and connections among them were considered as edges (weighted and directed).

Networks present a natural approach to showing social [47] or information systems [26]. We used Gephi software [35], version 0.9.2, for analyzing and displaying networks graphically. The NCDs stakeholder network was statistically examined concerning associative depth and associative clustering with Gephi software. These statistical characteristics were determined by applying different algorithms with Gephi. We selected the “Mike Bostock circle packing algorithm” [26]. We carried out analyses including degree, in degree, out-degree, weighted out-degree, closeness centrality, betweenness centrality, hub, authority and eigenvector centrality. (Please see Appendix A for more information

| Table 1 | Data collection structure for each council |
|---------|------------------------------------------|
| Council | Mission and objectives                      |
| Members |
| Structure |
| Approved resolutions |

| 1. X   | - Health-oriented objectives |
|        | - Objectives with an indirect relationship |
|        | - Unrelated health objectives |
| Members | - The president |
|         | - Ministries |
| Structure | - Organization |
| Approved resolutions | - MoHME |
|                   | - Position in the structure of authority |
|                   | - Chairman of the council |
|                   | - Secretariat |
|                   | - Committees |

| Table 2 | Definitions and scoring of the criteria of each council |
|---------|----------------------------------------------------------|
| Council | Definition                                                                 |
| Interest | As the number of approved resolutions related to NCDs<sup>a</sup> |
| Position | As a council that outlined a health-based mission and objectives in its statute, the MoHME had a significant role in guiding it |
| Power | As a statutory authority given to the council in the statute to deal with NCDs and related risk factors |
| Influence | The number of risk factors that can be influenced by the council |
| Scoring | Low, low-medium, medium, medium–high, and high, 0–5 / 6–8 / 9–12 / 13–15 and more than 15, respectively |

| Table 3 | Network elements |
|---------|------------------|
| Network elements as nodes | Nodes based on | Edges based on | Target |
| Members | - Ministry: strong |
|         | - Government organization: medium |
|         | - Private Sector and NGO<sup>a</sup>: poor |
| Councils | Based on Table 1 |
| SDGs<sup>b</sup> | Based on seven selected studies and reports [39–45] |
| Risk factors | Attribute DALY in 2017 |

| | |
| | |

<sup>a</sup> NCDs Non-Communicable Diseases

<sup>b</sup> NGOs Non-Governmental Organization, <sup>b</sup> SDGs Sustainable Development Goals, NCDs Non-Communicable Diseases
Recognizing the leverage points to make more use of the power of the stakeholders

“Leverage points”, defined as places within a complex system (a large company, economy, living body, city, ecosystem), where a small change in one point can make a big difference in the whole system, are important in system analysis. Identifying where leverage points are and how they can be reached is crucial to determining the points of power, as introduced in the Intervention Level Framework (ILF) (Fig. 1), as well as other complementary models of leverage points [48]. This model classifies the dimensions of the intervention level framework that can be used for reforms, whose aim is to increase the role of the Ministry of Health in the councils with an impact on population health.

Initial identification of interventions

On the basis of the interview results, initial interventions were determined. Document review was used to complete the initial list of interventions; all council documents (statutes, objectives, laws, structure, members, committees, approvals, processes, and reports, i.e. both official and grey literature) were collected and reviewed. The study team listed the initial interventions at different ILF levels and held several sessions to review and summarize the previous steps’ results.

Identification of final interventions

We obtained the viewpoints of 33 experts (Appendix B) using an online questionnaire containing the initial list of interventions. Moreover, we sought the experts’ views on the appropriateness and feasibility of the proposed interventions (Appendix B). All study steps were performed in accordance with the relevant ethical and research guidelines and regulations; and supervised by the ethics committee of Tehran University of Medical Sciences.

Results

We identified 113 national collective decision-making centers in the Islamic Republic of Iran’s administrative and legal system. Following the initial screening, 21 cases went into the next steps to identify each council’s effect on NCDs’ risk factors. These were the collective decision-making actors that were able to influence NCDs. All 21 councils were initiated within the government and had governmental and non-governmental members. Nevertheless, all members and non-members of the councils are obliged to observe these councils’ acts. The majority of the 50 members of these councils are from the ministries, while only seven members (14%) are non-governmental. We did not map out individual stakeholders, for example, honorary membership without the right to vote.

Estimated criteria, interest, position, power, and influence of key councils are shown in Table 4. The five councils had the highest evaluation score in the four criteria, including the Supreme Council of Health and Food Security, Supreme Council for Standards, Supreme council for

![Fig. 1 The Intervention Level Framework (ILF)](image)
Table 4  Councils and Stakeholders involved with the process of NCDs-related policymaking in Iran rated according to four items (interest, position, power, and influence)

| Number of Stakeholders (Members) | MoHME (Has a leadership role in the council; a green label) | Interest | Position | Power | Influence (on) | Type of influence |
|----------------------------------|-----------------------------------------------------------|----------|----------|-------|----------------|------------------|
| 1. Supreme Council of Health and Food Security | 16<sup>a</sup> Yes | High | High | High | High, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High fasting plasma glucose, High body mass index, High systolic blood pressure, High LDL cholesterol, Ambient ozone pollution, Occupational risks, Lead exposure, Ambient particulate matter air pollution, Impaired kidney function | Legislation, research, inter-sectoral cooperation, awareness |
| 2. Supreme Council for Justice | 10 No | Low | Low | Medium | Medium–high, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, Ambient ozone pollution, Occupational risks, Lead exposure, Ambient particulate matter air pollution, Occupational risks | Creating or amending judicial laws |
| 3. Supreme Council for Centers of Excellence in Medical Sciences | 15 Yes | High | High | Medium | High, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High fasting plasma glucose, High body mass index, High systolic blood pressure, High LDL cholesterol, Ambient ozone pollution, Occupational risks, Ambient particulate matter air pollution, Impaired kidney function | Specialized research in the field of each risk factor |
| 4. Supreme Council for Youth & Sports | 18 Yes | Medium–high | Medium–high | High | Medium, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High body mass index, High systolic blood pressure | Expansion of public sports facilities, awareness among youth about risk factors |
| Number of Stakeholders (Members) | MoHME (Has a leadership role in the council; a green label) | Interest | Position | Power | Influence (on) | Type of influence |
|----------------------------------|-------------------------------------------------------------|----------|----------|-------|----------------|------------------|
| 5. Supreme Council for Standards 29 | Yes | High | High | High | High, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High fasting plasma glucose, High body mass index, High systolic blood pressure, High LDL cholesterol, Ambient ozone pollution, Occupational risks, Lead exposure, Ambient particulate matter air pollution | Create or modify standards for sources of risk factors |
| 6. Supreme Council for Water 10 | No | Medium | Low-medium | Medium | Low, Dietary risk | Water policy for food production |
| 7. Supreme Council for Education 15 | No | Low | Low | Medium | Medium, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High body mass index, High systolic blood pressure, | Educate students and incorporate health-oriented lessons into their courses |
| 8. Supreme Council for Insurance 11 | No | Medium-high | Low-medium | Medium-high | Low, Dietary risk | Provision of minimum salaries for retirement and sickness |
| 9. Supreme Council of Health Insurance 14 | Yes | High | High | High | Medium-high, Drug use, Smoking, Alcohol use, High fasting plasma glucose, High body mass index, High systolic blood pressure, High LDL cholesterol, Occupational risks, Lead exposure, and Impaired kidney function | Preventive services coverage, Set franchise, Covering the uninsured and the poor |
| 10. Supreme Council of the Cultural Revolution 43 | Yes | Medium-high | Medium | Medium | Medium, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, and High body mass index | The main cultural policymaker in Iran |
| 11. Supreme Council for Science, Research & Technology 24 | Yes | Low-medium | Medium | Low-medium | Low-medium, Ambient ozone pollution, Occupational risks, Lead exposure | Research, especially in the field of industry |
| 12. Supreme Council for Environmental Protection 13 | Yes | High | High | High | Medium-high, Dietary risk, Ambient ozone pollution, Occupational risks, Lead exposure, Ambient particulate matter air pollution | The main policymaker in the field of soil, air, and water pollutants |
| 13. Supreme Council of Welfare and Social Security 13 | Yes | Medium-high | Medium-high | Medium-high | Low, Dietary risk | Welfare Policy Making |
| Number of Stakeholders (Members) | MoHME (Has a leadership role in the council: a green label) | Interest | Position | Power | Influence (on) | Type of influence |
|---------------------------------|----------------------------------------------------------|----------|----------|-------|---------------|-----------------|
| 14: Supreme Council for Labor and Employment | 22 | Yes | Low-medium | Medium | Medium | Low-medium, Dietary risk, Occupational risks | Employment promotion and determination of workers' rights and working conditions |
| 15: Supreme Council for Tax | 25 | No | Low-medium | Low-medium | Medium-high | Medium-high, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, Ambient ozone pollution, Occupational risks, Lead exposure, Ambient particulate matter air pollution | Determining tax policies in the area of risk factors resources |
| 16: Supreme Council for Urbanization | 14 | No | Low-medium | Medium | Medium-high | Medium, High body mass index, Ambient particulate matter air pollution, Lead exposure | Policymakers to build healthy cities in terms of physical activity, pollution, etc |
| 17: High Council for Land Preparation and Analysis | 20 | No | Low | Medium | Medium | Low, Dietary, Ambient particulate matter air pollution | The exponential location of the creation of cities, agricultural areas, Estimating the reception capacity of the population of the regions |
| 18: National Council for the Elderly | 18 | Yes | Medium-high | High | Medium | High, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use, High fasting plasma glucose, High body mass index, High systolic blood pressure, High LDL cholesterol | Determining welfare and health policies for the elderly |
| 19: Social Council of the country | 26 | Yes | Medium-high | Medium-high | Medium-high | Medium, Dietary risk, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use | Fighting social harm and protecting people exposed to social harm |
| 20: Iran Drug Control Headquarters | 12 | Yes | Medium-high | Medium-high | High | Medium, Second-hand smoke, Drug use, Smoking, Chewing tobacco, Alcohol use | Policy on tobacco, alcohol, and drugs |
| 21: Hygienic monitoring and control committee on toxins and chemicals | 6 | Yes | Medium-high | High | High | Medium, Dietary risk, Occupational risks, Lead exposure | Main policymaking in the field of agricultural pesticides and hazardous chemicals |

*a* 1. President (Chairman); 2. Minister of Health and Medical Education (Secretary); 3. Head of the Country Management and Planning Organization; 4. Minister of Education; 5. Minister of Agriculture Jihad; 6. The Minister of Commerce; 7. Minister of Industry, Mine, and Trade; 8. Minister of Cooperatives, Labour, and Social Welfare; 9. Minister of the Interior; 10. Minister of Justice; 11. Minister of Energy; 12. Minister of the case under review; 13. Head of IRIB; 14. Head of Department of Environment; 15. Head of Physical Education Organization; 16. Head of the Medical Council of Iran

*b* 1. President as Chairman; 2. Head of National Standard Organization as Secretary; 3. Head of Management and Planning Organization of Iran; 4. Head of Iranian Department of Environment; 5. Ministers of Economic Affairs and Finance; 6. Ministry of Science, Research and Technology; 7. Ministry of Roads and Urban Development; 8. Ministry of Agriculture Jihad; 9. Ministry of Industry, Mine and Trade; 10. Ministry of Health and Medical Education; 11. Ministry of Petroleum; 12. Ministry of Energy; 13. Ministry of Cooperatives, Labour, and Social Welfare; 14. Ministry of Communication & Information Technology; 15. Ministry of Defence and Armed Forces Logistics; 16. Prosecutor-General of Iran; 17. Head of Inspection Organization Of Iran; 18–19. Two Members of Parliament; 20. Head of Iran Chamber of Commerce, Industries, Mines and Agriculture; 21. Head of Iran Cooperative Chamber; 22. Head of Iran Chamber of Guilds; 23–26. Four experienced experts in standard affairs; 27. Head of IRIB; 28. Head of National Qualification Center of Iran; 29. Head of the Competition Council
Environmental Protection, Supreme Council of Health Insurance, and Supreme Council for Centers of Excellence in Medical Sciences of Medical Sciences. The matrix of councils based on their interest and power has also been analyzed and mapped (Fig. 2).

The computed network metrics, including degree, closeness, betweenness, and eigenvector centralities, are reported in Appendix C. The importance of nodes in information flow is measured by betweenness centrality. The highest values in Betweenness centrality are found in the Supreme Council for Standards (427.59), Supreme Council of Health and Food Security (332.45), National Council for the Elderly (218.66), and Supreme Council of Health Insurance (194). Eigen Centrality measures a node's influence in a network based on the number of linkages it has to other nodes. The Supreme Council for Youth and Sports (0.0407), the Supreme Council for Standards (0.0374), the Supreme Council for Labor and
Employment (0.0315), the Supreme Council for Environmental Protection (0.0310), and the Supreme Council for Health and Food Security (0.0295) have the highest Eigen Centrality values.

Figures 3 and 4 show the network map drawn based on Table 3. The map also outlines the SDGs with the effects on the risk factors that are related to NCDs. Figure 3 shows each risk factor’s contribution to the burden of disease through the edge diameter, while Fig. 4 shows all characteristics (actors, councils, SDGs, Risk Factors, and NCDs). The MoHME and the President of the Islamic Republic of Iran were identified as the most active actors on selected councils, with the out-degree value of 13. SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) with out-degree value four could affect most NCD’s risk factors.

Figure 3 shows the contribution of risk factors to the burden (DALY) of NCDs in Iran. The greater diameter of the edges displays a greater contribution of the risk factor to the associated disease burden.

Figure 4 shows the whole network, including members, councils, risk factors, and NCDs. The dark green represents state actors such as ministries, institutes and parliament. The blue edges show the membership of actors, and the blue nodes show the selected councils with a potential influence on the risk factors (Light green nodes). The contribution of risk factors to the burden (DALY) of NCDs (Red nodes) are also displayed with red edges.

Our findings indicate macro-level interventions required to target public policies and translate them to policymakers, aiming to design more meaningful interventions by the MoHME to enhance intersectoral legislation and policies for the prevention and control of NCDs. Our study also revealed the councils and their potential capacities for the prevention and control of NCDs, which have not been sufficiently attended by the MoHME so far.

Table 5 summarizes the proposed interventions based on the ILF model depend, drawn from the expert’s opinion.
Discussion

This research aimed to identify collective decision-making centers in the government of Iran and determine the extent to which their capacity and function can address NCDs' related risk factors. Our study revealed that while members of each council can have a different impact on the risk factors of NCDs, the identified stakeholders and councils have different values of interest, position, power, and influence on Iran's NCDs-related policies. Based on its constitution's mission statement, the SCHFS is accountable for guiding ISC on health through its many bilateral and multilateral cooperations with relevant ministries and organizations [49].

The highest closeness centrality and betweenness centrality measures were related to the Supreme Council of Health and Food Security, the Supreme Council for Standards, and it shows the impact of this Council. Usually, when a node is important and is a network hub, not only does it have a high degree centrality but also a high centrality according to other centrality measures (betweenness, closeness). Moreover, different centrality measures have different implications. For example, closeness centrality shows access to other nodes, while eigenvector centrality shows the node’s importance due to the importance of its neighbors. The highest closeness centrality and betweenness centrality measures were related to the Supreme Council of Health and Food Security and the Supreme Council for Standards, highlighting their superior impact.
| Level                | Proposed Intervention                                                                                                                                                                                                                                                                                                                                 | Appropriateness | Feasibility |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|
| **Paradigm**        | 1. Continuous insistence and emphasis on health in all policies in the approaches of the Councils to attract attention and change the attitudes and values of key council members (changing the values of key individuals)                                                                                                                                  | High            | Medium      |
|                     | 2. Planning to reform and improve the organizational culture with health values in councils and members (ministries) (changing organizational values)                                                                                                                                                                                                        | High            | Low         |
|                     | 3. Frequently challenging hypotheses, values, and priorities that are harmful to health in supreme councils                                                                                                                                                                                                                                           | High            | Very low    |
|                     | 4. Identifying the educational and social centers in which council members were trained before reaching their positions and inject health-oriented principles into the training of these centers and communities                                                                                                                                               | Medium          | Low         |
| **Goals**           | 1. Developing new health-related goals for supreme councils to improve community health                                                                                                                                                                                                                                                                  | High            | Medium      |
|                     | 2. Preparing the essential prerequisites for achieving the national health goals related to the responsibilities of each council and delivering them to the secretariat of the supreme councils                                                                                                                                              | High            | High        |
| **System structure**| 1. To membership in supreme councils with significant effect over health determinants                                                                                                                                                                                                                                                                    | High            | High        |
|                     | 2. Using weighted ballots in supreme councils with more weight of votes of the representative of the Ministry of Health in health-oriented affairs                                                                                                                                                                                                    | Very High       | Low         |
|                     | 3. Combining supreme councils (with relevant specialized committees), for example, combining councils dealing with welfare, social affairs, and community health                                                                                                                                                                                                 | High            | Low         |
|                     | 4. Expanding health secretariats in other ministries and directing them to influence representatives of relevant ministries in supreme councils                                                                                                                                                                                                     | High            | Medium      |
|                     | 5. Improving the communication structure of the representative of the Ministry of Health in the supreme councils with the management body and units, offices, and specialized centers of the MoHME                                                                                                                                                  | Medium          | High        |
|                     | 6. Creating a database and developing the health-based information flow system related to the tasks and mission of each council                                                                                                                                                                                                                      | Medium          | High        |
|                     | 7. Establishing inter-ministerial committees and working groups at the level of experts in the sub-councils                                                                                                                                                                                                                                             | High            | Medium      |
| **Feedback and delays** | 1. Monitoring policies and approvals of councils to respond immediately to possible undesirable approvals                                                                                                                                                                                                                                 | Medium          | Medium      |
|                     | 2. Creating negative feedback loops (e.g., legal and punitive action against harmful approvals)                                                                                                                                                                                                                                                                | High            | Medium      |
|                     | 3. Defining index-based critical values to provide negative feedback on councils (Like a thermostat, it prevents the system from collapsing and keeps it within safe boundaries)                                                                                                                                                                                      | High            | Medium      |
|                     | 4. Controlling and slowing down positive feedback loops in the relationship between councils and their members (for example, ministers use their influence on council members to advance their programs that harm public health)                                                                                                                                 | High            | Low         |
|                     | 5. Organizing lectures, meetings, and specialized publications related to councils and their field of work                                                                                                                                                                                                                                                  | Low             | High        |
|                     | 6. Providing feedback on the effects of the activities of high councils and ministries and organizations to people and specialized communities to create sensitivity and awareness in society                                                                                                                                             | Low             | Medium      |
|                     | 7. Creating feedback loops in places that did not exist before and involving a wide range of stakeholders in feedback                                                                                                                                                                                                                                         | Medium          | High        |
| **Structural elements** | 1. Allocating a special workforce to deal with the affairs of each council in the MoHME                                                                                                                                                                                                                                                                  | Medium          | High        |
|                     | 2. Using human resources training (representative of the MoHME and following team in councils) to improve leadership skills, promote cooperation, and manage conflict of interest situations                                                                                                                                                  | High            | High        |
|                     | 3. Extracting policies and inter-sectoral interventions of national health programs and network them with supreme councils                                                                                                                                                                                                                                     | Low             | High        |
|                     | 4. Trying to commit commitment to allocate resources to members of the councils until the commitment to goals without the operational program                                                                                                                                                                                                         | Medium          | Medium      |
|                     | 5. Prioritize public health issues related to supreme councils based on disease burden and mortality or approximate time for reform                                                                                                                                                                                                                  | High            | High        |
|                     | 6. Establishing a health-oriented point in the process of reviewing, approving, and evaluating policies in councils                                                                                                                                                                                                                                           | High            | Medium      |
Building capacity for risk-based interventions is crucial to implementing appropriate NCD policies and enhancing members’ commitment to each council. Here, we will discuss the two leading councils in the prevention and control of NCDs and related risk factors in Iran:

1. The SCHFS: Its most important mission is to “coordinate and make policy on all matters related to public health and food security and nutrition”, aiming to materialize the notion of health in all policies. In other words, the Council is in charge of developing inter-sectoral collaboration between the MoHME, as the steward of the health sector, and other relevant organizations within the health system. In addition to its national structure with the president and several ministers as its members, the council has its provincial branches led by the governor of the province. The SCHFS has been enacted in various areas (Table 6).

The Council covers most risk factors related to NCDs and attempts to include them within relevant legislation, research, and cross-sectoral cooperation while acting to enhance awareness. The SCHFS approved the National action plan for preventing and controlling NCDs in Iran. This led to the establishment of the Iranian Non-Communicable Diseases Committee (INCDC) within the MoHME [10]. So far, to foster multisectoral collaboration through the SCHFS, the INCDC has signed 14 agreements with other ministries and national organizations for NCDs’ risk reduction.

2. The Supreme Council for Standards (SCS) is responsible for policymaking related to the National Standard Organization (NSO) of Iran. The NSO has 34 national committees to set national standards. Except for medicines and health services, all products and services should be approved by the NSO. The NSO reviews or create over 2000 standards set every year. It also assesses the compliance of goods or services with established standards. The SCS can reduce NCDs’ prevalence by targeting materials, whose consumption can increase NCDs’ related risk factors (Table 4). The SCS has a greater potential to guide standard-setting policies in the NSO towards further preventive measures. The standards of products such as beverages, sauces, canned foods, juices, sugar, compote, ready meals and auto parts are also determined by this organization.

As the MoHME has a representative in these councils, it can potentially open a window of opportunity in the Iranian administrative system towards reducing unhealthy behaviors and other NCDs’ risk factors. Based on the law, the decisions of these Councils are legally binding for everyone (ministries, organizations, the private section, etc.). The SCHFS also supports studies aiming to reform membership, voting processes, and prioritization of issues [50]. To promote public health initiatives, especially related to NCDs, it is necessary that values, skills, information systems, and organizational subsystems in these councils be reviewed and supported through the vital capacity of the MoHME’s role-playing. Likewise, the SCS supports a screening framework for health impact assessment [18]. Legal and regulatory reforms’ role in the global and national response to NCDs is more significant than

| Areas enacted by the SCHFS |
|----------------------------|
| National elderly policy, indicators of health equity, Health Promotion Strategic Plan for eight agricultural products, engagement with NGOs for NCDs, national action plan for prevention and control of NCDs, Air pollution and other pollutants, milk consumption, National Physical Activity Program, National Policy on Nutrition and Food Security, Health in All Policies, Soil pollution, Broadcasting and Commercialization and Advertising, Tobacco, Wastewater and Urban Development. |
it has been acknowledged. Some researchers have investigated the importance of intersectoral legislation in implementing WHO’s “best buys” and other recommended interventions. They pointed out that successful implementation of the preventive interventions, particularly in the LMICs, depends on the new legislation and reform of existing laws and standards [19, 36, 51]; Therefore, legislative leverage could be an effective and affordable means to control NCDs and their related risk factors.

Collaboratives Core dimensions of connectivity in public health collaborators such as network membership, network interaction, the health department’s role, frequency of interactions, strategic value, trust, and reciprocity are critical to the success of multisectoral partnerships [11]. Our study showed that the MoHME is a member as well as leads many councils, while its vote is equal to other members for adopting policies by a majority vote of 50%+1. As the MoHME is the guardian of population health, we advocate the weighted voting for the MoHME in the councils to help councils make better and stronger decisions for more meaningful prevention and control of NCDs [52].

The statutes of councils state that voting is based on members’ opinions. Accordingly, the most important action for health-centered decisions in the Supreme Councils is to express its importance and provide health-oriented values and evidence to the council members by the MoHME representative, mostly the minister of health & medical education or his/her representative.

NCD’s Risk factors are multidimensional; for instance, unhealthy nutrition stems from several dimensions, including proximal factors (food habits, lifestyle, and lack of education) and distal factors (poverty, illiteracy, food processing industries, tax system, supply and demand system, agriculture, import and export, minimum income). This study reconfirmed that each of these dimensions could be addressed through the councils and their members to make good policies for public health. As the president is the leader of most supreme councils, s/he can act as a catalyst for multisectoral and multi-stakeholder actions on NCDs.

NCDs and their risk factors are complex and multidimensional; addressing their unpredictable and long-term outcomes requires heterogeneous interaction and meaningful intersectoral collaboration. Social science methods for exploring complex systems, e.g., system dynamics, agent-based modeling, and network analysis, can help measure and analyze the relationships and flows among multiple and complex actors. The literature is tiny about using these methods to better manage NCDs and relevant risk factors [39]. Our study revealed that supreme councils could facilitate the creation of evidence support, setting goals & targets, coordination, advocacy, monitoring & evaluation, policy guidance, financial support, providing legal mandate, and help better implementation & management of NCDs [34].

The proposed intervention at the paradigm and goal levels are long-term actions that will face significant resistance. At lower intervention levels, Creating a database and implementing a health-related information flow system to support each council’s tasks and missions; Creating negative feedback loops; Defining index-based critical values to provide negative feedback is a balancing or reinforcing intervention [53]. Balancing this feedback loop necessitates prevention measures, early detection, and treatment initiation and completion [54], which can be accomplished through Structural Elements, Feedback, and Delays.

Limitations
There are some limitations to this study. First, despite our efforts, some participants were unwilling to participate in the study. Another limitation of this study is the lack of consideration for informal contact (edge) among stakeholders; there also may be a conflict of interest among the identified stakeholders that have not been addressed.

Conclusions
A wide range of stakeholders impacts the risk factors for noncommunicable diseases. We identified the key actors for each risk factor by analyzing stakeholders and their social networks. The Ministry of Health and Medical Education (MoHME) can use the ability of identified stakeholders to improve risk factor management by implementing the various (levels and types) of interventions identified in this study. The interventions recommended for the identified stakeholders have the potential to improve ISC, which is crucial for more effective prevention and management of modifiable risk factors for NCDs. Supreme councils and their members could serve as key nodes in implementing tailored inter-sectoral initiatives to address the risk factors for NCDs. While COVID-19 and the massive changes in the epidemiological transition might challenge the prioritization and budget allocation to fight against NCDs, social analysis of stakeholders will help, we envisage, focus on actors with the most influence to roll back the global movement to tackle NCDs and reach sustainable societies, in Iran and probably beyond.
Abbreviations
NCDs: Non-Communicable Diseases; SNA: Social Network Analysis; SCHFS: Supreme Council for Health and Food Security; SGS: Supreme Council for Standards, SCP: Supreme Council for Environmental Protection; SCH: Supreme Council for Health Insurance; MoHME: Ministry of Health and Medical Education; ISC: Inter-Sectoral Collaboration; YLL: Years of Life Lost; DALYs: Disability-Adjusted Life Years; LMICs: Low and Middle-Income Countries; UMICs: Upper-Middle-Income Countries; IAH: Intersectoral Action for Health; MDG: Millennium Development Goals; SDGs: Sustainable Development Goals; INCDC: Iranian Non-Communicable Diseases Committee; NGO: Non-Governmental Organization.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s12889-022-14041-8.

Additional file 1: Appendix A. We have provided the concepts of network analysis in Appendix A to assist the readers in understanding.

Additional file 2: Appendix B. defines the concepts of "appropriateness" and "feasibility," the field of knowledge of experts and their numbers are also stated.

Additional file 3: Appendix C.1, Network and node-level metrics. Appendix C.2, Network metrics, including degree, closeness, betweenness, and eigenvector centralities, computed for the different risk factors.

Acknowledgements
The authors would like to thank the MoHME’s authorities and staff. In particular, we are grateful to the SCHFS secretariat-the MoHME, for their invaluable contribution to data collection and interpretation of findings.

Authors’ contributions
AT and AB conceived the study. AT supervised all phases of evaluation and critically revised the manuscript; he is guarantor. RM, AO, MA, NRG provided experiences working with councils, critical feedback and helped shape the research, analysis and manuscript. The authors read and approved the final manuscript.

Funding
This research is part of a Ph.D. thesis in health policy, supported by the Tehran University of Medical Sciences and the National Institute of Health Researches of Iran.

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author upon a reasonable request.

Declarations
Ethics approval and consent to participate
This study received ethical approval from the Ethical Committee of the Tehran University of Medical Sciences (Approval number 9321460002); written informed consent was provided by all participants prior to data collection; all methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
AT and AO are members of the INCDC at the MoHME-Iran. AO is Director-General for NCDs at the MoHME. We have no conflict of interest to disclose. AB, RM, MA and NRG declare that they have no competing interests.

Author details
1Health Equity Research Centre (HERC), Tehran University of Medical Sciences, Tehran, Iran. 2Department of Global Health and Public Policy, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. 3Department of Health Management, Policy and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. 4Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. 5Osteoporosis Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran. 6Center for Non-Communicable Disease Control, Ministry of Health and Medical Education, Tehran, Iran. 7Secretariat of Supreme Council of Health and Food Security, Ministry of Health and Medical Education, Tehran, Iran.

Received: 23 July 2021 Accepted: 22 August 2022 Published online: 02 September 2022

References
1. World Health Organization. Noncommunicable diseases country profiles 2018. World Health Organization; 2018. https://apps.who.int/iris/handle/10665/274512. License: CC BY-NC-SA 3.0 IGO.
2. Bloom DE, Cafero ET, Jané-Llopis E, Abrahams-Gessel S, Bloom LR, Fathima S, et al. The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum; 2011.
3. Peykari N, Hashemi H, Dinarvand R, Haji-Aghajani M, Malekzadeh R, Sadrolisadat A, et al. National action plan for non-communicable diseases prevention and control in Iran; a response to emerging epidemic. J Diabetes Metab Disord. 2017;16(1):3.
4. Peykari N, Hashemi H, Aghaee G, Ayazi M, Janbabaei G, Malekzadeh R, et al. Sientometric study on non-communicable diseases in Iran: a review article. Iran J Public Health. 2018;47(7):936–43.
5. Azadnajafabad S, Mohammadi E, Aminrooyae A, Fattahi N, Rezaei S, Haghighenasr R, Rezaei N, Naderimaghmash S, Lanjani B, Farzadfar F. Non-communicable diseases’ risk factors in Iran, a review of the present status and action plans. J Diabetes Metab Disord. 2021;22:1–9.
6. Murray CJ, Arvinik AH, Zheng P, Abaffyi C, Abbas KM, Abbas-Kangevari M, Abb-d-Allah F, Abdellali M, Abdollahi M, Abdollahpour I, Abegaz KH. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 2020;7,199610258;1223–49.
7. Bloom DE, Cafero E, Jané-Llopis E, Abrahams-Gessel S, Bloom LR, Fathima S, et al. The global economic burden of noncommunicable diseases Program on the Global Demography of Aging. 2012.
8. Takian A, Bakhhtiari A, Ostoar A. Universal health coverage for strengthening prevention and control of noncommunicable diseases in COVID-19 era. Med J Islam Repub Iran. 2020;34(1):1050–3.
9. World Health Organization. WHO package of essential noncommunicable (PEN) disease interventions for primary health care. World Health Organization; 2020. https://apps.who.int/iris/handle/10665/334186. License: CC BY-NC-SA 3.0 IGO.
10. Amerzadeh M, Salavati S, Takian A, Namaki S, Asadi-Lari M, Delpisheh A, et al. Proactive agenda setting in creation and approval of national action plan for prevention and control of non-communicable diseases in Iran: the use of multiple streams model. J Diabetes Metab Disord. 2020;29:1–2.
11. Varda DM, Chandra A, Stern SA, Lurie N. Core dimensions of connectivity in public health collaboratives. J Public Health Manag Pract. 2008;14(5):E1–7.
12. Giles-Corti B, Vernez-Moudon A, Reis R, Turrell G, Dannenberg AL, Badland H, et al. City planning and population health: a global challenge. Lancet. 2016;388(10062):2912–24.
13. Mialon M, Swinburn B, Sacks G. A proposed approach to systematically identify and monitor the corporate political activity of the food industry with respect to public health using publicly available information. Obes Rev. 2015;16(7):519–30.
14. World Health Organization. Regional Office for Africa Multi-stakeholder dialogue on risk factors for non-communicable diseases. 2013.
15. Hospedales CI, Jane-Llopis E. A multistakeholder platform to promote health and prevent noncommunicable diseases in the region of the Americas: the Pan American Health Organization partners forum for action. J Health Commun. 2011;16(Suppl 2):191–200.
16. Pearlman PC, Vinson C, Singh T, Stevens LM, Kostecky B. Multi-stakeholder partnerships: breaking down barriers to effective cancer-control planning and implementation in low-and middle-income countries. Sci Dipl. 2016;5(1):1–15.
