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Review Article

The Relationships between Social Capital, Metabolic, and Behavioral Risk Factors of Non-Communicable Diseases: A Systematic Review

Mohammad Mehdi Kiani [1,2], *Amirhossein Takian [1,2,3], Farshad Farzadfar [4], Shahabeddin Rezaei [4], Hamed Zandian [5]

1. *Department of Health Management, Policy and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
2. *Health Equity Research Center (HERC), Tehran University of Medical Sciences, Tehran, Iran*
3. *Department of Global Health and Public Policy, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
4. *Non-Communicable Diseases Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, Iran*
5. *Social Determinants of Health Research Center, Ardabil University of Medical Sciences, Ardabil, Iran*

***Corresponding Author:** Email: takian@tums.ac.ir

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Abstract

Background: Contextual risk factors such as social capital have a vital role in affecting behavioral and biological risk factors of NCDs. We aimed to systematically identify the relationship between different aspects of social capital (SC) with metabolic, and behavioral risk factors of non-communicable diseases (NCDs).

Methods: This is a systematic review. The period of study was 2000-2021. We searched the English international databases, i.e. PubMed/Medline, Scopus, and Web of Science. Studies that reported NCDs' metabolic and behavioral risk factors as independent variables, were excluded. We also included studies if they analyzed the association between SC and metabolic and behavioral risk factors of NCDs.

Results: After the primary and quality appraisal process, 97 studies were entered in the final phase of the analysis. Five out of 18 studies reported an inverse association between SC and the level of alcohol drinking. Twenty-seven out of 32 studies reported a significant inverse association between SC and smoking and tobacco use, while only one study reported a significant positive association. Nine studies reported a significant inverse association between SC and high blood pressure. Three studies showed a significant inverse association between SC and diabetes. Seventeen studies indicated a significant positive association between SC and physical activity. Thirteen out of 17 studies reported a significant inverse association between SC, body mass index (BMI) and overweight.

Conclusion: High SC, people's participation and interaction are vital in tackling NCDs. Evidence shows positive effects of SC on prevention, control and improvement of NCDs' metabolic and behavioral risk factors.

Keywords: Social capital; Non–communicable diseases; Behavioral risk factors; Metabolic risk factors

Introduction

Non–communicable diseases (NCDs) are responsible for 41 million (about 71%) of the 57 million deaths worldwide (1). NCDs' main risk factors have been increasing in the last three decades, hence the global burden of NCDs has raised dramatically (2).

The four major NCDs [cardiovascular diseases (CVDs), cancer, chronic respiratory disease, diabetes] are strongly linked with four behavioral risk factors: unhealthy diet, tobacco use, alcohol use, and physical inactivity (1). In addition, behavioral risk factors lead to reinforcement and change in metabolic risk factors: high blood pressure, high fasting plasma glucose, increased body mass index (BMI) and Dyslipidemia (3). These risk factors have a synergic effect on prevention and control of NCDs, meaning that reducing one risk factor can reduce the risk of more than one disease. Furthermore, the contextual risk factors have a vital role in affecting behavioral and biological risk factors of NCDs (3).

Many researchers have defined SC as "features of social organization, such as norms, networks and trust, which can improve the status of society (4, 5). SC has four levels: the "macro" level (social, political and economic context), the "meso" level (neighborhood or community), the individual-level behaviors, and the individual-level attitudes (6). SC is also divided into structural or behavioral (e.g. participation) and cognitive (e.g. trust) dimensions (7). The structural component includes extent and intensity of associational links or activity, and the cognitive component covers perceptions of support, reciprocity, sharing and trust. Recent evidence considers the social environment as a multi-faceted social determinant of health (SDH), which can improve or deteriorate health status through several mechanisms (8). With growing recognition of the SDH, SC is an increasingly important concept in health research. Different theories have demonstrated the relationship between SC and health. The increasing knowledge about the relationship between social factors and public health has meaningfully contributed to the development of SC (9). The components of SC, such as trust, cooperation, and social belonging, which are sources of vitality and happiness, have direct effects on health (10). Moreover, evidence shows a positive association between SC and prevention and control of chronic diseases, i.e., NCDs. Ample evidence supports the relationship between different dimentions of SC and health status measures, all-cause mortality and NCDs(11, 12), e.g., cancer, type 2 diabetes and cardiovascular disease (13, 14). Nevertheless, some other studies found no such relationship (15, 16). Hence, the relationship between SC, metabolic, and behavioral risk factors of NCDs remains unclear.

This systematic review aimed to clarify the relationship between different aspects of SC with metabolic, and behavioral risk factors of NCDs.

Methods

This is a systematic review of the literature on the relationship between SC and metabolic and behavioral risk factors of NCDs. We searched the nternational databases, i.e. PubMed/Medline, Scopus, and Web of Science, in English. The study period was 2000- 2021, a period of significant increase in the publication of related literature in this field. We used a PRISMA flow diagram and a narrative approach for synthesizing the evidence. The terms included in the search were: Participation, Institutional linkages, collective action, Degree of citizenship, Social Support, Emotional support, Trust, Sense of belonging, Alcohol Drinking, Blood glucose, Plasma glucose, Hypertension, Blood pressure, Smoking, Tobacco Use, Overweight, Feeding Behavior, Hypercholesterolemia, BMI.

Inclusion and exclusion criteria

We included studies if they had metabolic and behavioral risk factors of NCDs' outcome. Studies that reported NCDs' metabolic and behavioral risk factors as independent variables, were ex-

cluded. We also included studies if they analyzed the association between SC and metabolic and behavioral risk factors of NCDs, as well as protocol studies.

Studies Quality Assessment

We used the Newcastle-Ottawa Scale for the critical appraisal of the included studies from the primary screening stage (17). Two members of the team (MMK, ShR) assessed the studies. In case of any disagreement, the corresponding author (AHT) assessed the studies

Data Synthesis

Data on the included studies were extracted by M.M.K. and Sh.R, using a checklist that included the author (s') names, year of publication, title, study type, main results, dimensions of SC, Risk factors, followed by extraction and categorization of the results of each study. Included studies were heterogenous and we used narrative synthesis approch to describe the key aspects of each study.

Ethics Approval

This study was approved by the ethical committee of Research Ethics Committees of NIMAD, under the ethical code no: IR.NIMAD.REC.1398.027.

Results

We identified 984 studies from three databases and excluded 329 duplicates. After primary reviewing and screening of studies, 79 studies were included final. Figure 1 summarizes the flowchart of the literature review and data extraction process, in line with PRISMA protocol.

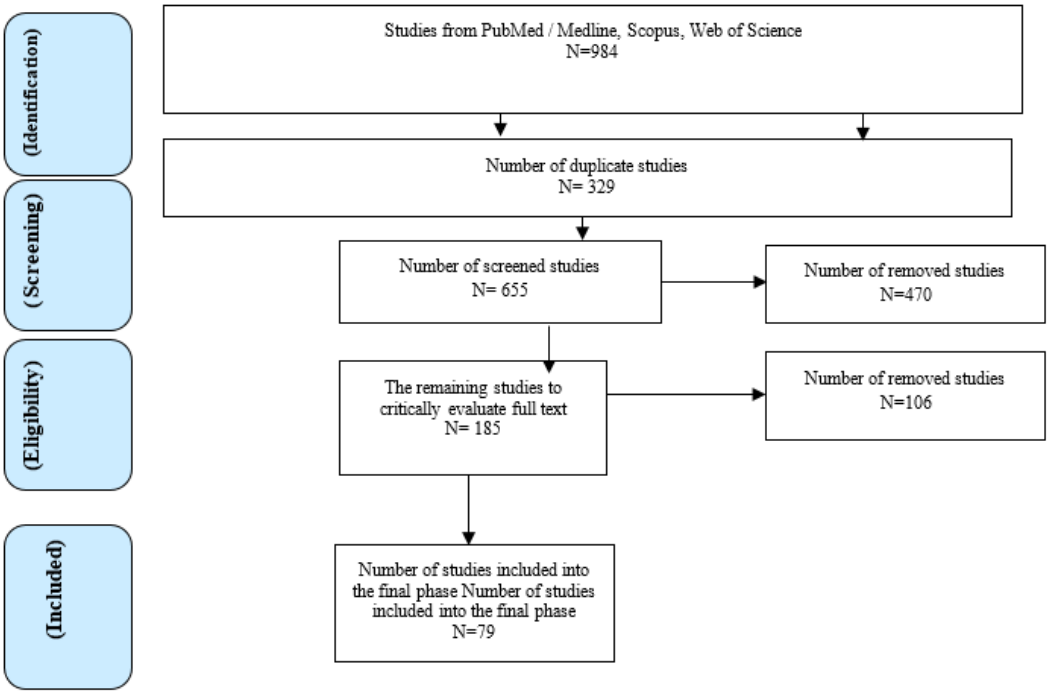

Fig. 1: Literature review and data extraction flow chart

We categorized the included studies based on five characteristics: study design, outcome variables, method of analysis, level of study, and the publication year, as described in Tables 1-2. Since some studies investigated more than one outcome variable, the total number of included articles in the data-analyzing category was 110 (instead of 79 actual papers included in this review).

Table 1: Characteristics of the included studies

Characteristics		*Number*	*Percentage*
Study design	Cross-sectional	55	70
	Interview	3	3.75
	Cohort	8	10
	Review	1	1.25
	Secondary analysis	12	15
Outcome variable	Blood pressure	9	8.2
	Diabetes	3	2.7
	Physical activity	18	16.4
	BMI, obesity, overweight	17	15.5
	Smoking and tobacco use	31	28.2
	Healthy diet - consumption of fruits, vegetables	9	8.2
	Alcohol-drinking	17	15.5
	Other variables	6	5.5
Study Level	Provincial	39	48.8
	National	41	51.3
Year of publication	2000-2005	6	7.6
	2006-2010	15	19.0
	2011-2015	29	36.7
	2016-2018	17	21.5
	2018-2021	12	15.2

Table 2: Summarizes the characteristics of included studies, i.e. setting, Study design**,** dimensions of SC, risk factors and results

Ref	*Setting*	*Study design*	*Dimensions of SC*	*Risk Factors*	*Association SC and Risk Factors*
(17)	Iran	Correlational	SC	Physical inactivity	Inverse
(18)	USA	Cross-sectional	Neighborhood cohesion, social network density	Alcohol	Positive
(19)	Iran	Cross-sectional	SC	Smoking	Inverse
(20)	China	Secondary data	Trust/ participation	Obesity	Inverse
(21)	USA	Cross-sectional	SC	Fruit / vegetable	Positive
(22)	New Jersey	Cross-sectional	SC	Physical inactivity	Inverse
(23)	China	Cross-sectional	Social ties, trust	Hypertention	Inverse
(24)	South Korea	Cohort	Social Trust	Level of blood pressure, fasting blood glucose, triglycerides, high-density lipoprotein cholesterol	Inverse
(25)	India	Cross-sectional	Community engagement, social support, trust, social cohesion	Tobacco	Positive(for women)
(26)	Romania	Cross-sectional	SC	Smoking	Positive association for active social life, Inverse association for Regular church attendance
(27)	Iran	Cross-sectional	SC	Overweight, obesity	Inverse

(28)	China	Cross-sectional	SC	Physical activity	Positive
(29)	Montreal-Canada	Secondary data	Social isolation, number of kin ties, network SC, generalized trust, social participation.	BMI	Inverse
(30)	USA	Cross-sectional	Trust, cohesion.	BMI	Inverse
(31)	Turkey	Survey	Family support Neighborhood Trust-Informal social control-Teacher–student interpersonal trust-Students interpersonal trust-' collaboration in school	Physical activity	Positive
(32)	China	Panel Studies	Social trust, social relationship, membership	Healthy diet, physical inactivity, smoking, sleeping, non-overweight status	significantly associated with four of the five: healthy diet, physical activity, sleeping and non overweight.
(33)	Norway	longitudinal data	Trust	Smoking	Inverse
(34)	US	Survey	SC	physical activity	Positive
(35)	21 countries	Cross-sectional	Membership of any social organization-trust in organizations	Hypertension	Inverse
(36)	South Korea	Interviews	Social participation-Trust	Physical activity	Positive
(37)	UK	Cohorts	Trust-Social participation-marital status	Smoking	Inverse
(38)	Iran	Cross-sectional	Individual trust- Cohesion/social support- Social trust/associative relationships	Smoking	Inverse
(39)	Sweden	Postal survey	Social support, trust, trust, membership of an organization, voting in election	Alcohol	Structural SC were associated with an increased probability of hazardous alcohol use. the increased probability associated with cognitive dimensions mainly occurred among women. Sense of coherence was robustly associated with a decreased probability of hazardous alcohol use.
(40)	US	Cohort	Social Cohesion	Hypertension, diabetes	Inverse
(41)	Japan	Survey	SC in the workplace	BMI	No associations
(42)	Zagreb City, Croatia	Survey	Family SC- trust-social control- Reciprocity	Physical activity	Positive
(43)	Belgium, France, Hungary, Netherlands, UK.	Cross-sectional	Social , social cohesion	Obesity, fruit, physical activity	Inverse
(44)	Hong Kong	Cross-sectional	Number of friends	Overweight, Obesity, Smoking	Inverse

(45)	Denmark	Cross-sectional	Social networking with colleague, social support	Alcohol	Inverse
(46)	Brazil	Secondary data	SC	Physical activity - fruit, vegetable	Positive
(47)	Flemish Belgium, Canada	Cross-sectional	Participation , voluntary organizations, trust and reciprocity in family	Smoking	Inverse
(48)	Austria	Cross-sectional	SC	Obesity	Inverse
(49)	Okinawa	Cross-sectional	Structural SC	Smoking, drinking	Inverse association for extracurricular activity Positive association for participation
(50)	Brazil	Cohort	SC	Leisure-time physical activity-fruits, vegetables- smoking-binge drinking	Positive
(51)	South Korea	Cross-sectional	SC	Smoking, drinking, aggression, and rule-breaking behaviors	Inverse
(52)	Brazil	Cross-sectional	Neighborhood SC	Smoking	Inverse
(53)	Montreal-Canada	Cross-sectional	Network SC.- Social isolation	Smoking	Inverse
(54)	USA	Cross-sectional	Social cohesion	Smoking	Inverse
(55)	US schools	Secondary data	SC	BMI	Inverse
(56)	Osaka- Japan	Cross-sectional	SC	Overweight	Inverse
(57)	Former Soviet Union	Survey	Social isolation, civic participation, help in a crisis, interpersonal trust	Alcohol	Inverse association/ while community interpersonal trust decreased these odds.
(59)	South Africa	Secondary data	Social action, sociability, trust, solidarity, safety, and civic engagement	Physical activity	Inverse
(58)	Haiti	longitudinal data	Groups, networks-Trust-Collective action-Personal empowerment	Hypertension	Inverse
(59)	Finland	Survey	Social support, participation and networks, trust and reciprocity	Smoking, alcohol, physical activity, vegetable consumption, sleep	Inverse association for Smoking, alcohol use, physical inactivity and Positive association vegetable consumption, sleep
(60)	-	Integrative review	SC	Health risk behaviors	SC is an important construct for understanding the establishment of health risk behaviors
(61)	China	Cross sectional study	SC	Smoking	Inverse
(62)	Japan	Interviews	Trust, helpfulness, conversable sense	Systolic blood pressure	Inverse
(63)	Iceland	Cohorts	SC	Smoking	Inverse
(64)	Netherlands	Cross-sectional	Neighborhood SC-Neighborhood variance	Smoking, Alcohol , Physical inactivity	Inverse

(65)	Canada)	Postal survey	Generalized trust, and participation	Physical inactivity	Inverse
(66)	US	Cohort	Social cohesion, trust, reciprocity	Systolic blood pressure	Inverse association for Male /No association between workplace SC and hypertension was found for women.
(67)	US	Survey	Family support-Family cohesion-Family conflict-Friend support-Neighborhood cohesion	Smoking	Inverse
(68)	Japan	Correlational	Fairness- trust- helpfulness	Hypertention	Inverse
(69)	Japan	Cross-sectional	Trust	Smoking, drinking	Inverse
(70)	US	Cross-sectional	SC	Obesity	Inverse
(71)	UK	secondary data	trust- participation	Smoking	Inverse
(72)	Japan	Cross-sectional	Trust, reciprocity	Smoking	Inverse
(73)	Japan	Cross-sectional	Trust-bonding, bridging SC	Physical inactivity	Inverse
(74)	Southern Sweden	Cross-sectional	Trust- Political trust in the Riksdag	smoking	Inverse
(75)	Finland	Cohort	SC	Smoking	Inverse
(76)	Sweden	Cross-sectional	Institutional trust	Alcohol	Inverse
(77)	Taiwan	Cross-sectional	Neighborhood closeness, Political influence, social contact, trust, participation	Smoking, Alcohol	Inverse association for Smoking/ Positive association for drinking
(78)	Canada	Cross-sectional	Network SC –Trust-Participation	BMI	Inverse
(79)	Australia	Cross-sectional	SC	Physical inactivity	Inverse
(80)	US	Panel Data	SC	Alcohol	Inverse
(81)	Bolivian Amazon	Cross-sectional	SC	BMI	Positive
(82)	USA	Survey	Social support-Social leverage-Informal social control-Social cohesion-	Smoking	Increase in social is associated with a 56% increase in the odds of smoking increase in informal social control is associated with a 45% reduction in the odds of smoking
(83)	Sweden	Secondary data	Trust	Smoking	Respondents with low trust in the healthcare system had significantly higher odds ratios of daily smoking. while respondents with low trust in the mass media had no significant odds ratios of daily smoking.
(84)	Australia	longitudinal data set	Trust/safety	Smoking	Inverse
(85)	USA	Survey	SC	obesity, physical inactivity	Inverse association for physical inactivity and for obesity was not significant.
(86)	USA	Cross-sectional	SC	Obesity, Diabetes	Inverse

(87)	England	Secondary data	Social support-Trust-participation	Fruit/vegetable	Positive
(88)	Sweden	Interviews	participation-trust	Alcohol	high social participation/low trust, had significantly higher risks of high alcohol consumption
(89)	USA	Cohorts	Volunteerism	Alcohol	Inverse
(90)	Sweden	Cross-sectional	participation	Smoking	Inverse
(91)	Sweden	Cohort	participation	Smoking	Inverse

The association between social capital, metabolic and behavioral risk factors of NCDs

Table 3 summarizes the results. There was little evidence of an inverse association between SC and the level of alcohol drinking, with five from 16 studies reporting high levels of SC associated with a lower risk level of alcohol drinking. Twenty-five out of 29 studies reported a significant inverse association between SC ,smoking and tobacco use, while only one study reported a significant positive association. Seven studies reported a significant inverse association between SC and blood pressure/ hypertension. Two studies found a significant inverse association between SC and diabetes. Sixteen studies indicated a significant positive association between SC and physical activity. Eleven out of 15 studies reported a significant inverse association between SC and BMI. In contrast, only one study reported such a significant positive association.

Table 3: The relationship between SC, metabolic and behavioral risk factors

Items	*Inverse association*	*No association*	*Positive association*	*Correlation*
SC & Hypertension	9	0	0	0
SC & Diabetes	3	0	0	0
SC & Physical activity	0	0	17	0
SC & BMI, obesity, overweight	13	2	1	1
SC & Smoking, tobacco use	27	1	1	3
SC & Healthy diet - consumption of fruits, vegetables	0	1	8	1
SC & Alcohol-drinking	5	2	11	0

Discussion

Our review included 79 studies that determined the relationship between SC, metabolic and behavioral risk factors of NCDs. Generally, our findings demonstrate that SC has an important role in improving NCDs' metabolic and behavioral risk factors. SC can influence health through different pathways. First, the provision of social support that allows a person to believe that s/he is cared for and loved, esteemed and valued, and belongs to a network of mutual obligation. Second, social influence can affect through shared norms or social control. Third, social engagement and social participation, which result from the representation of the potential roles in real life.

The last pathway is person-to-person contacts, which are especially relevant in certain behaviors such as secondhand cigarette smoking or shared food or drinks.

SC was associated with hypertension and diabetes. Lack of fairness, helpfulness, trust (as cognitive SC) are the factors identified with an essential role in reducing blood pressure (24,34,62,68). Cognitive SC (VS structural SC) has a contextual effect on blood pressure as a metabolic risk factor of NCDs. SC and physical activity had positive association (28, 42,65,73, 92). Among all dimensions of SC, trust and social participation had an important role in enhancing activity among study participants. As the main dimension of SC, trust can promote other components of SC, i.e. social networks or social participation, which can lead to increasing of physical activity, consequently (93).

Social participation is an organized process in which individuals are characterized by specific, collective, conscious and voluntary actions. This might lead to better and easier access to resources, e.g. ideas, information, money, services or favors, etc. Other factors including perceived control, neighborhood SC (the networks, norms, values and understandings that facilitate cooperation within or among groups), social network and social cohesion, can reciprocally enhance physical activity. Older adults without a spouse or companion may have reduced contact with neighbors and less access to physical activity-related resources in their neighborhoods. Lower social support and safety can be a significant barrier to leisure-time physical activity. The consistency among studies, despite slightly different measurement questions and the various socio-cultural contexts, suggests a robust association between these factors and physical activity.

In most articles, SC was inversely associated with BMI, obesity and overweight (20,43,56,70,78). One study showed a devastating effect of SC on BMI (81). Strong relationship between individuals can lead to more homogeneous networks with similar norms and behavior. Further, this study confirmed the role of trust and network capital as being protective against obesity (30). One study showed no association between SC and obesity. This discrepancy might be related to the cultural context of the study, Japan, where the prevalence of obesity is generally low. Let alone, most participants in this study were men, which may affect the study results.

Our review also showed an inverse association between SC and smoking (18, 24). Similar to other studies (94), we found that togetherness and enhancing SC can improve the levels of emotional stress. One explanation might be that the dimension of SC can reduce the effects of stress through enhancing the individual's coping abilities. High SC can promote awareness about the risks of smoking, adopt anti-smoking norms and increase access to resources and amenities.

SC showed a positive effect on the consumption of fruits and vegetables (46,50,59), perhaps as a result of enhancing and exchanging information among people. Only one study showed no association between improving SC and good nutrition, e.g. consumption of enough fruits and vegetables. Changing dietary pattern is the fundamental consequence of demographic and nutrition transition, with a dramatic impact on the prevalence of NCDs. Interactions and relationship between people might lead to imitation of dietary pattern.

Our synthesis showed various effects of SC on alcohol consumption. SC is associated with both more and less binge drinking. Most studies reported a positive relationship between SC and alcohol consumption. We found that SC can occasionally be adversely related to alcohol consumption and drinking, related to the negative aspect of SC that associated with person-to-person contacts that was explained earlier (95). Whereas, social participation is positively associated with drinking (18,87). Likewise, higher levels of social support in the neighborhood could be associated with higher likelihood of binge drinking, because social interaction might stimulate alcohol intake in some settings. Social norms at a social- or community-level have influence on health behaviors. Trust showed a spectrum of opposite effects on alcohol consumption, as it sometimes might lead to increasing consumption

of alcohol, whereas it sometimes brings alcohol consumption down (51,57), very much depending on the society's social context. Associations differ depending on type of SC and type of binge behavior.

Despite all strengths, this review was unable to include all databases. Moreover, selected papers were performed in various geographical areas, followed different methods, and included various sample size, influenced the results.

Conclusion

High SC, people's participation and interaction are vital in tackling NCDs. Evidence shows positive effects of SC on prevention, control and improvement of NCDs' metabolic and behavioral risk factors. Furthermore, metabolic and behavioral risk factors can mediate the association between SC and NCDs. Prevention and control of NCDs is a multidimensional, complex, and expensive task. A whole of government/whole of society approach is essential to combat NCDs. As most NCD risk factors are preventable through lifestyle change, attention to SC as a main contextual factor might be a cost-effective approach for meaningful prevention and control of NCD, along the pathway towards sustainable health development in all settings.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

AT and FF are the members of the National Committee for Prevention and Control of NCDs in Iran. Authors declare no conflict of interest, real or perceived.

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