http://jhmi.sums.ac.ir
Health Man & Info Sci 2024, 11(2), 76–84

HMIS
Health Management and Information Science

Original Article

Social Capital and Covid-19 Vaccination Coverage: An Ecological Study of 130 Countries

Mohadeseh Ghanbari-Jahromi[1], Zahra Maleki[2], Leila Jahangiry[3], Farzaneh Moasheri[1], Fatemeh Rezaei[1*]

[1]Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran
[2]Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Health Education and Health Promotion Department, School of Health, Medical Education Research Center, Health Management and Safety Promotion Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran

Abstract

Introduction: The effect of COVID-19 vaccination coverage on the role of social capital as an essential dimension in disease prevention is undeniable. This study investigated the correlation between Covid-19 vaccination coverage and social capital.

Methods: This ecological study used aggregate data from 130 countries. A fully vaccinated index was used to cover the COVID-19 vaccination. The main variable was the cumulative fully COVID-19 vaccinated population share data, which was retrieved from Our World in Data repository. The data related to social capital was retrieved from the global sustainable competitiveness databases.

Results: Cumulative fully vaccinated population shares related to COVID-19 were 46.83%. The higher rate of cumulative fully vaccinated population shares related to Covid-19 was reported in the United Arab Emirates (90.28%), Portugal (88.98%), and Singapore (87.00%); also, the lower rate of cumulative fully vaccinated population shares related to Covid-19 were reported from Burundi (0.02), Chad (0.48), and Haiti (0.61). There was a positive significant association between cumulative fully vaccinated population shares and social capital (r=0.74, P<0.001). A positive significant association between cumulative fully vaccinated population shares and social capital was found in 39 high-income countries (r=0.33, P=0.03), 36 upper-middle-income countries (r=035, P=0.04), and 36 lower-middle-income countries (r=0.51, P=0.002).

Conclusion: A strong positive association was observed between cumulative fully vaccinated population shares and social capital in the countries. Appropriate interventions are needed to increase the level of social capital and its components in countries to increase access to vaccination and health status in countries in periods like a pandemic.

Keywords: Covid-19, Vaccination, Social capital, Income

Article History:
Received: 12 August 2023
Accepted: 20 December 2023

Please cite this paper as:
Ghanbari-Jahromi M, Maleki Z, Jahangiry L, Moasheri F, Rezaei F. Social Capital and Covid-19 Vaccination Coverage: An Ecological Study of 130 Countries. Health Man & Info Sci. 2024; 11(2): 76-84. doi: 10.30476/JHMI.2024.103696.1235.

***Correspondence to:**
Fatemeh Rezaei,
Research Center for Social Determinants of Health, Jahrom University of Medical Sciences, Jahrom, Iran
Email: frezaeik@yahoo.com

Introduction

Vaccination is widely seen as a major measure of protecting the population against Covid-19. It was estimated that to control Covid-19, 70-80% of the population should be vaccinated (1, 2). In the early stages of vaccine development in 2020, half of the US population did not intend to receive the vaccine due to concerns about vaccine safety and low vaccine trust (3, 4). Misinformation about vaccination in the media greatly reduced people's willingness to be vaccinated and some social groups were affected differently (5). Strong evidence shows that the ability of individuals to adopt new behaviors and follow public health recommendations is related to the structure of communities (6).

According to the socio-ecological model, an individual's behaviors are influenced by factors at various community levels such as interpersonal relationships (social support from friends and family), organization (rules, regulations, social norms, and values in the organization), society (an informal social network in society), and public policy (local and national politics) (7). Therefore, clarifying the fundamental factors influencing individual behaviors is essential to develop effective strategies to improve vaccine coverage. One of the possible factors that may affect vaccine acceptance is social capital (7, 8). Social

capital generally has three dimensions: networks, the norm of cooperation, and trust. Trust is an essential element for strengthening collaboration and predicting the behavior of others. Trust is a common and necessary factor for the acceptance of vaccines, especially the Covid-19 vaccine. One of the major barriers in receiving the vaccine is the fear of serious side effects. For example, there are several individuals and social groups who endorse anti-vaccine attitudes and have negative views about vaccines. In addition, it has been strongly reported that some levels of distrust are a key influential reason for vaccine hesitancy (9).

In particular, social capital in societies has been linked to health outcomes, such as vaccination coverage, mortality rates, obesity, and diabetes (10, 11); also, it can explain changes in health status and health-promoting behaviors in varied geographical areas (12). Given that during the COVID-19 pandemic, social distancing, mask-wearing, and vaccination were all essential prevention measures in the control of the disease, such behaviors are not equally accepted by different communities despite the availability of vaccination (13). Bartscher et al. investigated the impact of social capital on health outcomes during the COVID-19 outbreak in seven countries and found that increasing the standard deviation in social capital led to a decrease of 14% and 34% in COVID-19 occurrence per capita (14). Trust underlies many decisions in healthcare and affects vaccine acceptance as well as treatment adherence and health outcomes. Although trust in the physician-patient relationship has received a great deal of attention, trust in healthcare products such as vaccines and medicines has rarely been examined.

The effect of COVID-19 vaccination coverage on preventing the disease and the role of social capital as an essential dimension in disease prevention is undeniable. Therefore, this study aimed to investigate the correlation between COVID-19 vaccination coverage and social capital in 130 countries.

Methods

This ecological study used aggregate data from 130 countries to investigate the correlation between social capital and a cumulative fully vaccinated population. In this study, a fully vaccinated index was used to cover the COVID-19 vaccination. In this case, if a person has received a single-dose vaccine or both doses of the vaccine, he or she will be considered fully vaccinated.

In this study, the main variable was the cumulative fully COVID-19 vaccinated population share data on September 17, 2021, which was retrieved for 130 countries from the Our World in Data repository, and the data related to social capital updated in 2019 was retrieved from the global sustainable competitiveness databases (15, 16). Countries with a population greater than 1 million were included in the analysis. All the estimations were performed for 130 countries including Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belarus, Belgium, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Cyprus, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador Equatorial Guinea, Estonia, Eswatini, Ethiopia, Finland, France, Gabon, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Haiti, Honduras, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, North Macedonia, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Rwanda, Saudi Arabia, Senegal, Serbia, Sierra Leone, Singapore, Slovenia, Somalia, South Africa, South Sudan, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vietnam, and Zimbabwe.

Statistical Analysis

A scatter plot of the cumulative fully vaccinated population and social capital for 130 countries was depicted. As the data were not normally distributed, the Spearman correlation coefficient was estimated for the cumulative fully vaccinated population and social capital. According to the World Bank, countries were categorized into four groups of high-income, upper-middle-income, lower-middle-income, and low-income (17).

Table 1: Spearman correlation of the cumulative fully vaccinated population shares with social capital

Country	N	Correlation coefficient	P value	Comment*
Cumulative fully vaccinated population shares				
High income	39	0.33	0.03	Week
Upper middle income	35	0.35	0.04	Week
Lower middle income	36	0.51	0.002	Moderate
Low income	20	0.006	0.98	NS**
Total	130	0.74	<0.001	Strong

*00-0.19 "very weak", 0.20-0.39 "weak", 0.40-0.59 "moderate", 0.60-0.79 "strong", 0.80-1.0 "very strong"; **Indicates not significant

In the scatter plots based on income categories, the regions of the countries were presented. The World Bank has classified countries into seven regions including Latin America and Caribbean, the Middle East & North Africa, North America, South Asia, and Sub-Saharan Africa (17). Statistical analysis was performed using SPSS v.23 Chicago and a P-value less than 0.05 was considered as statistical significance.

Results

The results of the current ecological study showed that the cumulative fully vaccinated population shares related to COVID-19 were 46.83% among 130 countries. The higher rate of the cumulative fully vaccinated population shares related to COVID-19 was reported in the United Arab Emirates (90.28%), Portugal (88.98%), and Singapore (87.00%), and also the lower rate of the cumulative fully vaccinated population shares related to COVID-19 was reported in Burundi (0.02), Chad (0.48), and Haiti (0.61). The higher level of social capital was found in Norway (63.5), Sweden (62.4), and Finland (62.3), and the lower level was documented in Iraq (29.7), Egypt (30.8), and South Africa (31.1).

The association of the cumulative fully vaccinated population shares with social capital in 130 countries classified by income is shown in Table 1. There was a positive significant association between the cumulative fully vaccinated population shares and social capital in all 130 countries (P<0.001). Similarly, a positive significant association between the cumulative fully vaccinated population shares and social capital was found in 39 high-income countries, 36 upper-middle-income countries, and 36 lower-middle-income countries (P<0.05). However, this study did not find any relationship between the cumulative fully vaccinated population shares and social capital in 20 low-income countries (P>0.05).

Figure 1 shows the Scatter plot of the cumulative fully vaccinated population shares and social capital in all investigated countries. It is established that a cumulative fully vaccinated population shares social capital increases with social capital (R^2=0.533).

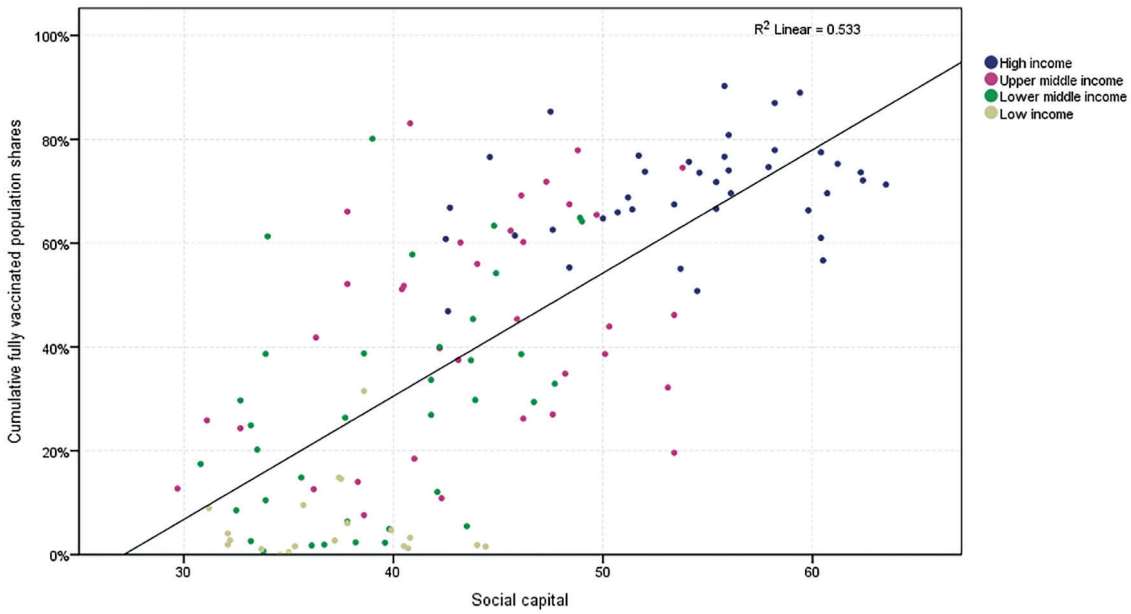

Figure 1: Scatterplot of the correlation between social capital with COVID-19 fully vaccinated population shares in 130 countries

The scatters' plots of the cumulative fully vaccinated population shares and social capital in high-income, upper-middle-income, lower-middle-income, and low-income countries are shown in Figures 2-5. According to the income classification of countries, the highest R-squared was observed in lower-middle-income (R^2=0.224), upper-middle-income (R^2=0.134), and high- income (R^2=0.114) countries.

Discussion

The current study investigated the association between COVID-19 vaccination coverage and social capital in 130 countries. The results of this study suggest that there was a strong positive association between the cumulative fully vaccinated population shares and social capital in the countries. The countries with a higher level of social capital had higher vaccination coverage rates than other countries (18). High-income countries probably had careful coordination for vaccine distribution (19). These findings highlight that much more is needed to be done to strengthen social capital elements including

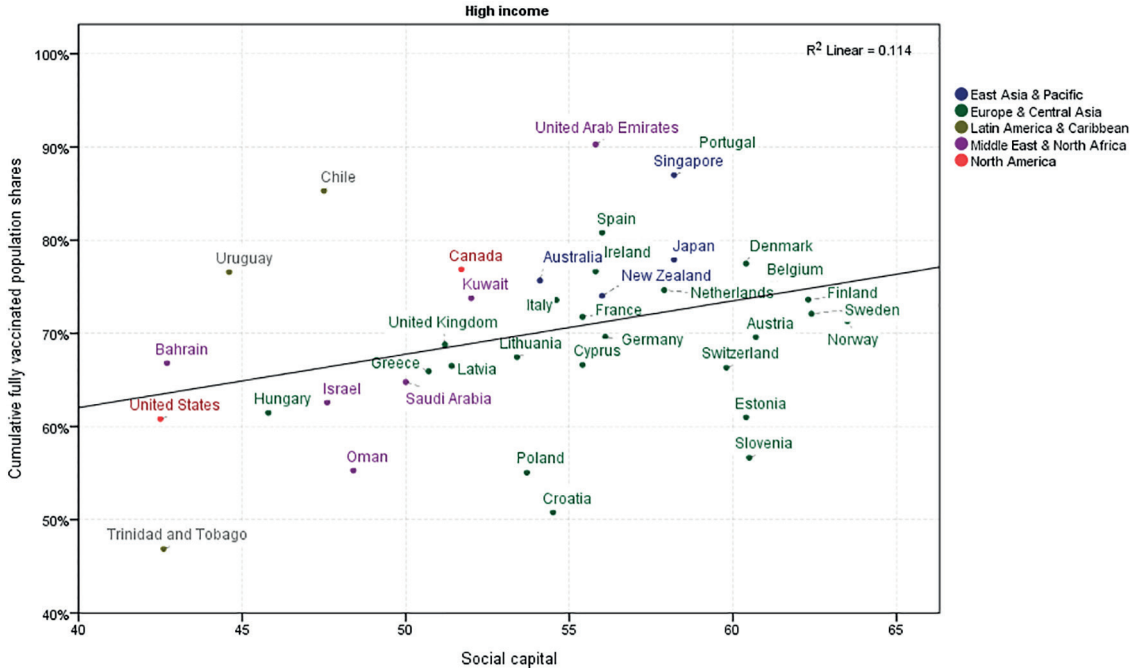

Figure 2: Scatterplot of correlation between social capital with COVID-19 fully vaccinated population shares in high income countries

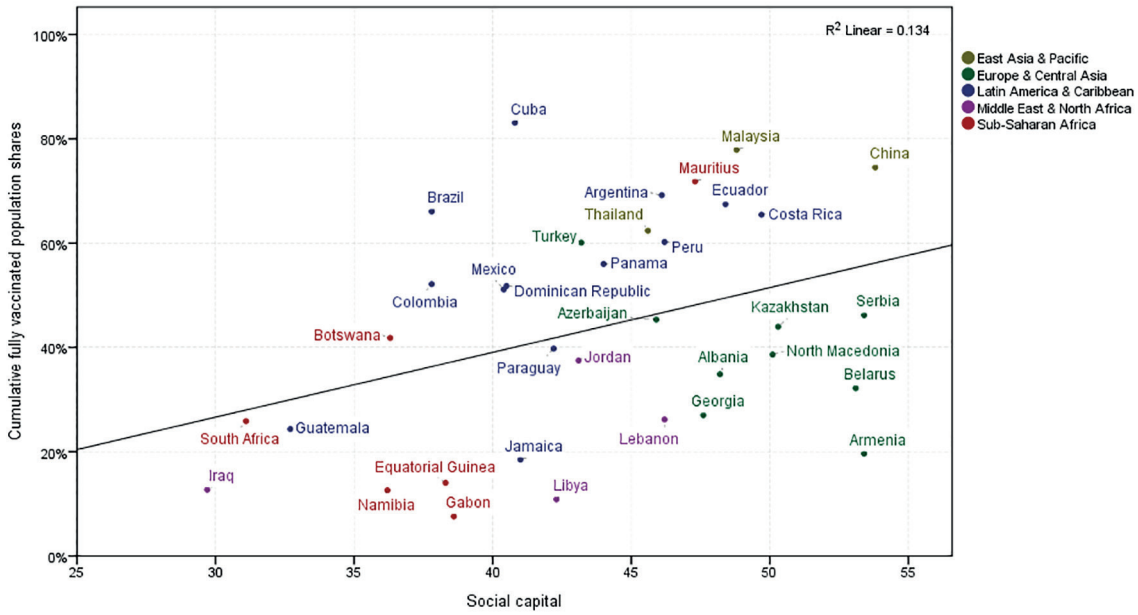

Figure 3: Scatterplot of correlation between social capital with COVID-19 fully vaccinated population shares in upper middle-income countries

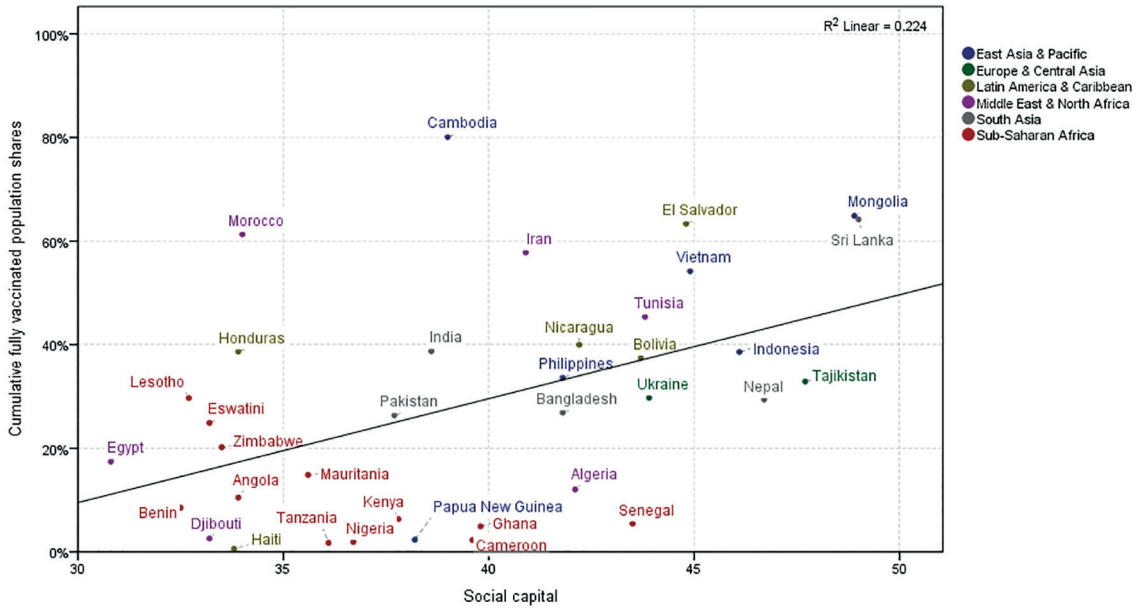

Figure 4: Scatterplot of correlation between social capital with COVID-19 fully vaccinated population shares in lower middle-income countries

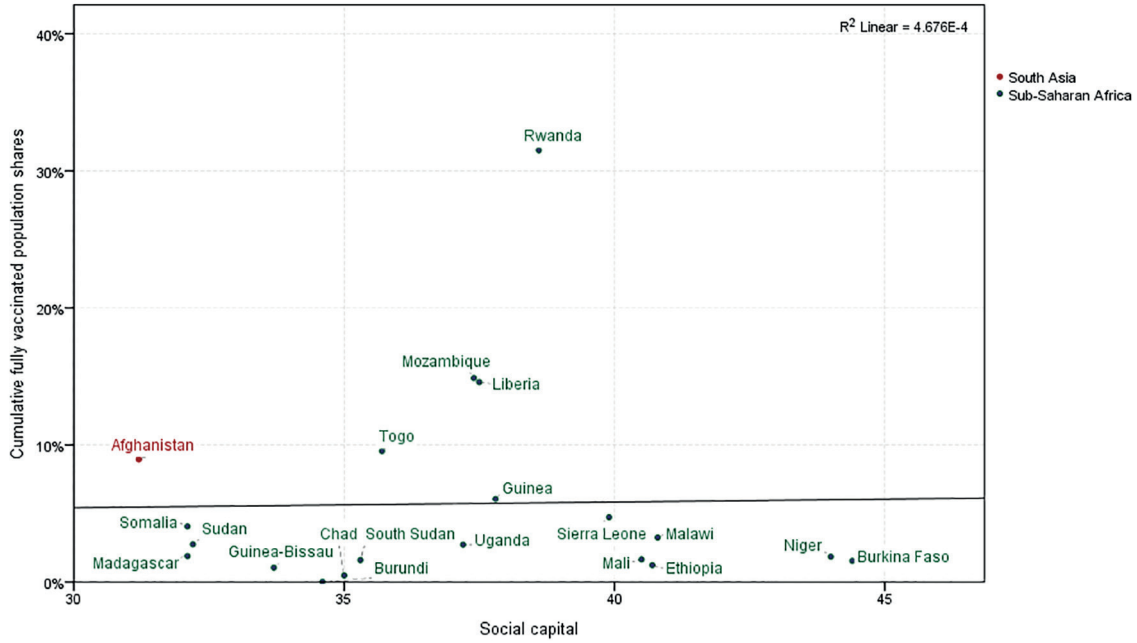

Figure 5: Scatterplot of correlation between social capital with COVID-19 fully vaccinated population shares in low-income countries

social networks, trust, and reciprocity (20). Social networks are the key element of social capital and refer to the relations between people and groups. Social networks describe people who had more and wider bonding and relations in the community as more likely to have information about vaccination (21).

To estimate a definite association between the cumulative fully vaccinated population shares and social capital among 130 countries, we used the World Bank income classes that categorized economics into low-income, lower-middle income, upper-middle-income, and high-income. The results showed that the highest and lowest levels of social capital was found in Norway and Iraq, respectively. Iraq is in the Middle East and as to income belongs to upper-middle-income countries. Consistent with this study, Gesthuizen et al. report that Iraq is projected to have the lowest level of social capital (22). According to our results, the lower-income and lower social capital are associated with relatively lower COVID-19 vaccination coverage. Furthermore, a study on COVID-19 vaccine acceptance in Iraq demonstrated that only one-half of the general population accepted the vaccine, about one-

half were hesitant, and about one-half rejected COVID-19 vaccines (23). There were variations in the acceptance of COVID-19 vaccination rates; for instance, the acceptance rate in China was 90% (24), in the USA 58% to 69% (24), and in Canada 76.5% (25). Although these variations between countries could be attributed to several social and economic factors including education and public awareness, the economy of the countries, and social and political conditions (26), it is easy to assume that the people's trust in their government and social capital plays a key role in vaccine acceptance and increase in vaccination coverage among countries (27).

Jung et al. reported that parents in countries with high levels of social capital were more likely to vaccinate their children for H1N1 (28). Media exposure in countries with high social capital helps increase people's knowledge and effectiveness of H1N1. Therefore, only the expansion of media coverage for vaccination is not enough, and it is necessary to carry out communication strategies to increase people's willingness to be vaccinated (28). Strong evidence shows that governments have a principal role in enhancing public trust in vaccination. The role of trust as an element of social capital in the vaccine's acceptance is vital (29), and it is related to the ability of governments to communicate and inform the benefits of vaccination (30). Another study consistent with our study reported that education and median household income played a significant role in the likelihood of vaccination (31).

Our results showed that there was a poor association between COVID-19 vaccination coverage and social capital in the countries with a high-level income. A study from Japan, a high-income country in East Asia, revealed that there was a significant positive relationship between Measles vaccination coverage rate and social capital. (32). This can be interpreted that the high level of social capital leads to access to vaccination, information, and media. Therefore, the desire of people to communicate and exchange health information will increase, so increasing the level of awareness and trust among people and willingness to be vaccinated will increase vaccine coverage (33). Probably, with the decrease in the level of social capital and income inequality in low-income countries, the measles vaccination coverage rate decreases (34).

The results of this study suggest that there was an intermediate significant association between COVID-19 vaccination coverage and social capital in the countries with lower-middle-income. In line with our results, Faers et al. reported that more than half of Egyptian health workers were undecided about COVID-19 vaccination, 28% refused, and only 21% accepted vaccination in a lower-middle-income country (18). It should be described that lower income and lower social capital reduce vaccine willingness.

Previous studies showed that poverty, living in inner cities, and unemployment status were associated with lower vaccination coverage. Additionally, there was an inverse relationship between income inequality and vaccination coverage (31).

Income inequality is associated with an investment in health-related social infrastructures, such as health care costs (35). Also, income inequality erodes social cohesion and is linked to adverse health consequences and increases high-risk behaviors (36).

Suggestions

Utilizing social media to inform about vaccinations is effective in building trust and sharing accurate information. Key methods include:

1. Creating engaging content: Use videos and infographics to simplify complex topics, along with relatable short posts that convey essential vaccine information.
2. Endorsements from reputable figures: Collaborate with trusted healthcare professionals and influencers to enhance credibility and reach diverse audiences.
3. Addressing questions and concerns: Respond to common doubts through informative posts and live Q&A sessions on social platforms.
4. Sharing success stories: Highlight experiences of vaccinated individuals and positive remarks from celebrities to inspire others.
5. Effective hashtag use: Employ relevant hashtags and targeted campaigns to increase visibility.
6. Multilingual content: Offer content in various languages to reach diverse cultural groups.
7. Emphasis on community health benefits: Illustrate how vaccines contribute to public well-being to strengthen the message.

Also, trust is crucial for vaccination acceptance. When individuals trust information sources, they are more likely to participate in

vaccination programs, such as:
1. Reducing fear: Trust in health institutions alleviates concerns about vaccine safety.
2. Faster acceptance: Trust in experts leads to quicker acceptance of their recommendations.
3. Combatting misinformation: Trusted sources lessen the impact of rumors.

Ways to build trust within communities include:
1. Transparency: Providing clear information about vaccine processes enhances trust.
2. Using credible sources: Engaging respected healthcare professionals for information helps build confidence.
3. Educational sessions: Both in-person and online education can improve understanding and trust.
4. Promoting positive narratives: Share vaccinated individuals' experiences on social media.
5. Community-health institution relationship: Create channels for direct communication between the community and health organizations to foster trust.
6. Countering misinformation: Use reliable sources to address false claims.
7. Engaging community leaders: Local leaders can effectively encourage vaccination and reinforce confidence in programs.

Strengths and Limitations

The current study is the first to investigate the correlation between COVID-19 vaccination coverage and social capital in 130 countries. Although most ecological studies are hypothesis-generating, the ecological fallacy and Simpson's paradox were the limitations of this study. Also, in this study, racial and ethnic diversity, socio-economic status, level of public view about the vaccine and how it is in different populations, and the influence of mass media on vaccine use and influential personalities in the public formation of vaccines have not been investigated. Therefore, it is recommended to examine the effect of these factors on vaccine availability in future studies.

Conclusion

In this study, a strong positive association between the cumulative fully vaccinated population shares and social capital in the countries was observed. The countries with a higher level of social capital had higher vaccination coverage rates than other countries. The results of this study suggest that there was an intermediate significant association between COVID-19 vaccination coverage and social capital in the countries with lower middle income. Appropriate interventions are needed to increase the level of social capital and its components in the countries to increase access to vaccination and to increase health status in countries in the conditions of a pandemic.

Suggestion for Future Research

Social Trust and Vaccine Uptake: The Role of Social Capital in COVID-19 Immunization

How Social Bonds Shape Vaccine Success: The Impact of Social Capital on COVID-19 Coverage

Social Capital as a Key Driver of COVID-19 Vaccine Coverage: Analyzing Global Trends

Community Strength and Vaccine Rollout: The Link between Social Capital and COVID-19 Coverage

Acknowledgement

We acknowledge the contributions of Jahrom University of Medical Sciences, Jahrom, Iran for providing facilities to the study.

Funding

The study has been funded by Jahrom University of Medical Sciences (JUMS) under the code of 400000149.

Authors' Contribution

MGHJ, FM, FR and LJ contributed to conceiving and designing the study. The data were collected by ZM. The collected data were analyzed and interpreted jointly by FR and FM. All authors had equal contributions in drafting and reviewing the manuscript. All authors have read and approved the final manuscript.

Data Availability Statement

The data collection tools and datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Statement

The study has been approved by ethics committee of Jahrom University of Medical Sciences under the code of IR.JUMS.REC.1400.075.

Conflict of Interest

There are no conflicts of interest.

References

1. Bartsch SM, O'Shea KJ, Ferguson MC, Bottazzi ME, Wedlock PT, Strych U, et al. Vaccine Efficacy Needed for a COVID-19 Coronavirus Vaccine to Prevent or Stop an Epidemic as the Sole Intervention. *Am J Prev Med*. 2020;59(4):493-503. doi: 10.1016/j.amepre.2020.06.011.
2. Robinson E, Jones A, Lesser I, Daly M. International estimates of intended uptake and refusal of COVID-19 vaccines: A rapid systematic review and meta-analysis of large nationally representative samples. *Vaccine*. 2021;39(15):2024-34. doi: 10.1016/j.vaccine.2021.02.005.
3. Ferwana I, Varshney LR. Social capital dimensions are differentially associated with COVID-19 vaccinations, masks, and physical distancing. *PLoS One*. 2021;16(12):e0260818. doi: 10.1371/journal.pone.0260818.
4. Szilagyi PG, Thomas K, Shah MD, Vizueta N, Cui Y, Vangala S, et al. National Trends in the US Public's Likelihood of Getting a COVID-19 Vaccine-April 1 to December 8, 2020. *JAMA*. 2020;325(4):396-8. doi: 10.1001/jama.2020.26419.
5. Loomba S, de Figueiredo A, Piatek SJ, de Graaf K, Larson HJ. Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA. *Nat Hum Behav*. 2021;5(3):337-48. doi: 10.1038/s41562-021-01056-1.
6. Bavel JJV, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and behavioural science to support COVID-19 pandemic response. *Nat Hum Behav*. 2020;4(5):460-71. doi: 10.1038/s41562-020-0884-z.
7. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351-77. doi: 10.1177/109019818801500401.
8. Kumar S, Quinn SC, Kim KH, Musa D, Hilyard KM, Freimuth VS. The social ecological model as a framework for determinants of 2009 H1N1 influenza vaccine uptake in the United States. *Health Educ Behav*. 2012;39(2):229-43. doi: 10.1177/1090198111415105.
9. Bogart LM, Ojikutu BO, Tyagi K, Klein DJ, Mutchler MG, Dong L, et al. COVID-19 Related Medical Mistrust, Health Impacts, and Potential Vaccine Hesitancy Among Black Americans Living With HIV. *J Acquir Immune Defic Syndr*. 2021;86(2):200-7. doi: 10.1097/QAI.0000000000002570.
10. Chuang YC, Huang YL, Tseng KC, Yen CH, Yang LH. Social capital and health-protective behavior intentions in an influenza pandemic. *PLoS One*. 2015;10(4):e0122970. doi: 10.1371/journal.pone.0122970.
11. Ehsan A, Klaas HS, Bastianen A, Spini D. Social capital and health: A systematic review of systematic reviews. *SSM Popul Health*. 2019;8:100425. doi: 10.1016/j.ssmph.2019.100425.
12. Kawachi I. Social capital and community effects on population and individual health. *Ann N Y Acad Sci*. 1999;896:120-30. doi: 10.1111/j.1749-6632.1999.tb08110.x.
13. Nawa N, Fujiwara T. Association between social capital and second dose of measles vaccination in Japan: Results from the A-CHILD study. *Vaccine*. 2019;37(6):877-81. doi: 10.1016/j.vaccine.2018.12.037.
14. Bartscher AK, Seitz S, Siegloch S, Slotwinski M, Wehrhofer N. Social capital and the spread of covid-19: Insights from european countries. *J Health Econ*. 2021;80:102531. doi: 10.1016/j.jhealeco.2021.102531.
15. SolAbility [Internet]. The Global Sustainable Competitiveness Index-Social Capital Index. c2024. Avialable from: https://solability.com/the-global-sustainable-competitiveness-index/the-index/social-capital.
16. Our World in Data [Internet]. Coronavirus (COVID-19) Vaccinations. [cited 31dec2021]. Available from :https://ourworldindata.org/covid-vaccinations.
17. Campos MC, Dombrowski JG, Phelan J, Marinho CRF, Hibberd M, Clark TG, et al. Zika might not be acting alone: Using an ecological study approach to investigate potential co-acting risk factors for an unusual pattern of microcephaly in Brazil. *PLoS One*. 2018;13(8):e0201452. doi: 10.1371/journal.pone.0201452.
18. Fares S, Elmnyer MM, Mohamed SS, Elsayed R. COVID-19 Vaccination Perception and Attitude among Healthcare Workers in Egypt. *J Prim Care Community Health*. 2021;12:21501327211013303. doi: 10.1177/21501327211013303.
19. Evans DR, Yemeke TT, Kiracho EE, Mutebi A, Apolot RR, Ssebagereka A, et al. Trust

in vaccines and medicines in Uganda. *Vaccine*. 2019;37(40):6008-15. doi: 10.1016/j.vaccine.2019.07.022.
20. Halpern D. Social capital. Cambridge: Polity; 2005.
21. Wilson SL, Wiysonge C. Social media and vaccine hesitancy. *BMJ Glob Health*. 2020;5(10). doi: 10.1136/bmjgh-2020-004206.
22. Gesthuizen M, Van der Meer T, Scheepers P. Ethnic diversity and social capital in Europe: tests of Putnam's thesis in European countries. *Scandinavian Political Studies*. 2009;32(2):121-42. doi: 10.1111/j.1467-9477.2008.00217.x.
23. Ghazi H, Taher T, Alfadhul S, Al-Mahmood S, Hassan S, Hamoudi T, et al. Acceptance of Covid-19 vaccine among general population in Iraq: Acceptance of Covid-19 vaccine among general population in Iraq. *Iraqi National Journal of Medicine*. 2021;3(1):93-103. doi: 10.37319/iqnjm.3.1.9.
24. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K, et al. A global survey of potential acceptance of a COVID-19 vaccine. *Nat Med*. 2021;27(2):225-8. doi: 10.1038/s41591-020-1124-9.
25. Frank K, Arim R. Canadians' willingness to get a COVID-19 vaccine: Group differences and reasons for vaccine hesitancy. Canada: Statistics Canada; 2020.
26. Guidry JPD, Laestadius LI, Vraga EK, Miller CA, Perrin PB, Burton CW, et al. Willingness to get the COVID-19 vaccine with and without emergency use authorization. *Am J Infect Control*. 2021;49(2):137-42. doi: 10.1016/j.ajic.2020.11.018.
27. Palanisamy B, Gopichandran V, Kosalram K. Social capital, trust in health information, and acceptance of Measles-Rubella vaccination campaign in Tamil Nadu: A case-control study. *J Postgrad Med*. 2018;64(4):212-9. doi: 10.4103/jpgm.JPGM_249_17.
28. Jung M, Lin L, Viswanath K. Associations between health communication behaviors, neighborhood social capital, vaccine knowledge, and parents' H1N1 vaccination of their children. *Vaccine*. 2013;31(42):4860-6. doi: 10.1016/j.vaccine.2013.07.068.
29. Rahn WM, Transue JE. Social trust and value change: The decline of social capital in American youth, 1976–1995. *Political Psychology*. 1998;19(3):545-65. doi: 10.1111/0162-895X.00117.
30. Co-operation OfE, Development. Enhancing public trust in COVID-19 vaccination: The role of governments. Paris: OECD Publishing; 2021.
31. Qiao S, Li Z, Zhang J, Sun X, Garrett C, Li X. Social Capital, Urbanization Level, and COVID-19 Vaccination Uptake in the United States: A National Level Analysis. *Vaccines (Basel)*. 2022;10(4). doi: 10.3390/vaccines10040625.
32. Nagaoka K, Fujiwara T, Ito J. Do income inequality and social capital associate with measles-containing vaccine coverage rate? *Vaccine*. 2012;30(52):7481-8. doi: 10.1016/j.vaccine.2012.10.055.
33. Moore S, Carpiano RM. Introduction to the special issue on "social capital and health: What have we learned in the last 20 Years and where do we go from here?". *Soc Sci Med*. 2020;257:113014. doi: 10.1016/j.socscimed.2020.113014.
34. Ali HA, Hartner AM, Echeverria-Londono S, Roth J, Li X, Abbas K, et al. Vaccine equity in low and middle income countries: a systematic review and meta-analysis. *Int J Equity Health*. 2022;21(1):82. doi: 10.1186/s12939-022-01678-5.
35. Ray D, Linden M. Health, inequality and income: a global study using simultaneous model. *Journal of Economic Structures*. 2018;7:1-28. doi: 10.1186/s40008-018-0121-3.
36. Pabayo R, Kawachi I, Gilman SE. US State-level income inequality and risks of heart attack and coronary risk behaviors: longitudinal findings. *Int J Public Health*. 2015;60(5):573-88. doi: 10.1007/s00038-015-0678-7.