Original Article

Healthy cities and self-reported health: evidence from Israel

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Abstract: The World Health Organization's Healthy Cities Network (HCN) enlists community stakeholders (residents, businesses, non-governmental organizations and municipal governments) to promote health, quality of life and sustainable development in urban settings. The project, now three decades old, involves thousands of municipalities globally, including 52 in Israel. However, there is very little evidence regarding the effects of joining the HCN. This study examines whether HCN membership affects residents' self-reported health (SRH). Social survey data for Israel's 13 largest cities in 2005–2017 were analyzed using difference-in-differences and event study research designs. We use the gradual entry of cities to the HCN to compare SRH before and after network entry. Examined variables include municipal spending on health and duration of the city's participation in the network. Data were analyzed through multivariate linear regression with fixed effects at the city and year levels. Joining the HCN does not have an immediate effect on SRH. SRH increases with the duration of the city's participation in the network, but this result is only marginally statistically significant. Municipal health spending mildly increases with membership duration. A weak negative association was found between municipal health spending and SRH. Duration of a city's membership in the HCN is positively associated with residents' SRH; this association is not explained by an increase in municipal health spending. Identifying a mechanism for this improvement is beyond the scope of this study and is left for future research.

Keywords: Healthy cities, self-reported health

Introduction

The World Health Organization's (WHO) Healthy Cities Network (HCN) was established in Europe in 1987 with the aim of implementing the WHO's 1986 'health for all' principles by the Ottawa charter for health promotion strategies and areas of action at the local level. Cities in the network agree that health is defined as a human right and make a political commitment to a systematic development of health within their borders. More specifically, the network aims to promote health and improve the quality of life and the environment in urban areas by enlisting local stakeholders, including organizations, businesses, local authorities and residents, to work together towards that goal. The network began in 1987 in 11 European cities as an experimental project of the European branch of the WHO. Today, the project has become an international movement involving thousands of municipalities and local authorities around the world (1–7).

The HCN has sparked considerable interest within the public health and health policy literatures (1,4,8–11). However, only a few studies explore the effect of joining the network on health outcomes. Most existing research on healthy cities focuses on implementation issues. A review by the WHO of the

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(This manuscript was submitted on 24 September 2020. Following blind peer review, it was accepted for publication on 23 November 2020.)

Global Health Promotion 1757-9759; Vol 0(0): 1–9; 984212 DOI: 10.1177/1757975920984212 journals.sagepub.com/home/ghp

HCN in 22 countries suggests that the health profiles developed by each city in the network capture the health status of the city better than mere data on morbidity and hospital admissions (11). A study in Japan evaluated the association between health indicators, such as preventative measures and closeness to health institutions, and actual health status in healthy cities (4). The study showed that health indicators were highly correlated with health status, but did not assess whether membership in the HCN improves levels of these health indicators or health in general. A study in Korea showed that healthy cities do promote intersectoral cooperation in the field of physical activity, at least to a certain extent, but did not show whether this resulted in better health for the population (5). A similar study in Europe evaluated the efforts of healthy cities in reducing smoking, alcohol consumption, malnutrition and lack of physical activity (12). While showing that healthy cities have indeed engaged in activities to promote these issues, the study does not assess their effectiveness.

Possibly the closest study to our work is a Korean study which explores whether living in a healthy city affects smoking, alcohol consumption and self-reported health (SRH) (6). While the results suggest this is indeed the case, they are based on a comparison of residents from only one healthy city and one city not in the network. Another limitation of the Korean study is its use of cross-sectional data, which means the results might be driven by pre-existing differences between the two cities and, therefore, cannot suggest causality.

In Israel, a HCN was established in 1990, under a joint initiative of the Ministry of Health and the health committee of the Federation of Local Authorities. The initial network consisted of four cities. As of 2018, the network included 52 Israeli cities, towns and local authorities, as well as government ministries, all four Israeli health maintenance organizations (HMOs) and academia (the Jerusalem school of public health) (13–17). Organizationally, the network is run from within the Federation of Local Authorities in Israel and is funded mainly by the Ministry of Health and an annual membership fee from its members. Israeli cities and towns, like those elsewhere in the world, must meet specific requirements for participation in the HCN (18). In particular, the HCN requires participating communities to produce an urban health profile and a strategic plan corresponding to the WHO's 'Health for All' and UN's 'Agenda 21' program goals;[1] to implement strategies agreed in the Ottawa Charter for Health Promotion; and to participate in network activities (7,18–22). These requirements are at least partially voluntary, as network administrators do not strictly monitor participating cities.

As is the case with the broader international literature, few studies specifically evaluate outcomes of the HCN in Israel. The most important existing study is that of Donchin *et al.* (7), who in 2004 examined implementation of the healthy cities principles and strategies within 18 participating cities. Donchin *et al.* found considerable variation between cities, and between different health measures within cities. For example, the study found that most participating cities achieved good collaboration between different sectors, but poor implementation of environmental protection measures. A few years later, Wetzler (23) evaluated the performance of Israel's healthy cities after 25 years of network activities, using mean data measured in 2009 and data for individual small cities, except for Ashkelon and Rehovot. This study did not find significant health improvements in participating cities. However, the small sample size and limited time frame did not allow for reaching definite conclusions.

The present study examined SRH in Israel's 13 largest cities, which together are home to about 40% of the country's Jewish population. The study takes advantage of the fact that these cities joined the HCN at different points in time. These 13 cities also comprise all those in the network for which SRH data were collected by the Israel Central Bureau of Statistics (ICBS). No Arab cities in the network were examined as SRH data for those localities are not available at the city level.

Methods

This study employs an event study research design. We use the gradual entry to the HCN as a source of variation regarding membership duration. We also perform a difference-in-differences analysis, comparing data from cities before and after they joined the network. We use data on the 13 largest cities in Israel, each with more than 100,000 residents (17), which entered the HCN between

1990 and 2015. The data are derived from two sources. The first is the Social Survey of the ICBS, which is completed by a national representative sample of roughly 7500 respondents a year (17,24). We obtained aggregated data for these 13 cities for 16 years, from 2002 to 2017, for a total of 208 observations.[2] The second source was budgetary data for all cities compiled by the Ministry of Interior, and, specifically, official audited financial statements for each city relating to each year from 2002 to 2017 (24,25).

Our main outcome variable is SRH. The Social Survey measures SRH using the question 'How do you evaluate your health generally on a scale of 1 to 4?', where one was defined as 'very good' and four as 'not at all good'. City-level data were obtained from the ICBS. Our SRH measure is the proportion of the city's respondents who answered 'good' or 'very good' (1 or 2 on the scale) in a given year. For example, our SRH measure for Tel Aviv in 2002 has the value of 80%, meaning that 80% of the respondents in Tel Aviv reported having good or very good health in 2002.

Our main explanatory variables were twofold: a dummy variable for being a member of the HCN, or a variable capturing the length of time a given city was part of the network at the time of data collection (data were taken from the HCN website). We controlled for several socio-economic variables, all averaged at the city level: age, education, gender, ethnic origin (Jewish or Arab), religiosity, average income and population.[3] Appendix Table 3 presents the summary statistics of the data.

Data analysis

The gradual admission of different cities to the HCN allows us to use an event study research design to compare outcomes before and after network entry. Entry to the network is not random, as cities made an active choice to join the network early or late. Hence, in order to infer a causal effect of being part of the network on health outcomes, a crucial assumption is that in the absence of participation in the network, health outcomes would develop similarly for residents of different cities. This common-trend assumption is the key identifying assumption of our research design.

We start by describing the baseline specification. We begin with a simple specification that assumes a permanent, immediate shift in outcomes following network entry, and is equivalent to a difference-in-differences equation:

$$y_{it} = \beta D_{it} + \alpha_i + \delta_t + \lambda X_{it} + \varepsilon_{it} \quad (1)$$

where y_{it} is the outcome of interest – SRH of city i in year t. The variable D_{it} is a dummy variable for whether city i was part of the network in year t. The coefficient estimate β represents the change in the outcome following network entry. α_i and δ_t are city and year fixed effects, respectively. X_{it} is a vector of socio-economic and demographic characteristics of residents of city i in year t: gender, age, religiosity, education and income. Throughout our analyses, we use standard errors clustered at the city level to allow for arbitrary dependence of ε_{it} across t within i.

Implementation of any reform may affect health outcomes (y_{it}) gradually and not immediately. To accommodate these issues, we allow for a gradual effect of the reform, by adding an interaction variable of reform status and time since the implementation:

$$y_{it} = \beta_1 D_{it} + \beta_2 D_{it} * trend_{it} + \alpha_i + \delta_t + \lambda X_{it} + \varepsilon_{it} \quad (2)$$

In this equation, $trend_{it}$ measures the years elapsed since the city joined the network, and takes the value zero before the reform. For example, two years after City A joined the network, its trend variable takes the value 2. This trend is interacted with the network membership dummy. The coefficient for the trend and membership interaction, β_2, represents the effect of participating in the network for an additional year. β_2 captures delayed effects of the reform and represents the annual change in outcomes in city i from the implementation year relative to the same city prior to the reform.

Equation (2) can be thought of as a parametric event study design, since we assume a post-reform trend and not a year-by-year effect. The high variability in year of entry to the network does not allow us to fully capture the effect of a specific post-reform year or control for a specific pre-reform year.

We use equations (1) and (2) to evaluate the effect of membership in the HCN on SRH using linear ordinary least squares (OLS) regression with

city-level and year fixed effects. In addition, we use equation (2) to evaluate how health spending is affected by network membership, and how health spending affects SRH.

A key issue with the analysis has to do with adjusting the standard errors for heteroscedasticity. We first assume that the variance of our variables is homoscedastic and perform the analysis of equations (1) and (2) using the regular standard errors. This assumption, however, is probably too strong since we deal with panel data – different observations belong to the same city, or to the same year. Variance between cities is probably different from variance within cities, meaning that the data suffers from heteroscedasticity. In order to deal with this issue, we perform another analysis of equations (1) and (2), using bootstrapped standard errors. Bootstrapping the standard errors is a common practice that corrects the standard errors for heteroscedasticity.

Results

Table 1 presents the results of estimating equations (1) and (2) for the dependent SRH variable, as well as for municipal health spending. In column 1 we estimate equation (1) in order to examine how the network entry variable and the control variables affect SRH. The equation estimates the immediate effect of network entry on SRH, with no progress over time. The results show no immediate constant effect of HCN entry on SRH.

In column 2 we estimate equation (2). As can be seen, again network membership has no immediate effect on SRH. However, our main interest is the coefficient for the interaction between the general trend variable and the network membership variable. This variable estimates the gradual effect of participating in the network. We find that this coefficient is positive and marginally statistically significant – that is, statistically significant at the 10% level. A one-year increase in membership duration increases SRH by 0.19 percentage points. This means that participation in the HCN does indeed increase SRH, and that this increase materializes over time. We do note that when we correct the standard errors for heteroscedasticity this coefficient is no longer statistically significant.

We also document the association between the various control variables and SRH. Residents of Jewish cities report higher subjective health compared to residents of mixed cities (Jewish and Arab), and cities with older residents have on average lower SRH. Finally, cities with more educated residents also report on average lower subjective health status.

One mechanism that might explain the change in SRH is rising municipal expenditure on health initiatives after a city joins the HCN. To test this association, we first examine whether either network membership per se, or network membership duration, affect municipal health spending. The results are shown in columns 3 and 4 in Table 1. In column 3 we see no immediate increase in municipal health spending as a result of network membership. In column 4 we do see a gradual increase in health spending during the membership period, which is statistically significant at the 10% level.[4] Every additional year of network membership increases municipal health spending by 366,000 New Israeli Shekels (NIS). Columns 3 and 4 also reveal other determinants of municipal health spending: Traditional Jewish and Secular Jewish are associated with lower health spending compared to ultraorthodox, and a higher monthly income of the residents is also associated with lower health spending by the city, again possibly because ultraorthodox spend more on health and are relatively poorer.

Next, we test whether the health budget is itself associated with the SRH measure. Table 2 represents the effect of municipal spending on health via the magnitude of municipal health spending without considering membership in the HCN. Again, a linear OLS regression with city-level and year fixed effects was performed to assess the relationship between health spending and SRH. Indeed, we found an association between SRH and municipal health spending at a significance level of $P < 0.005$, but in an unexpected direction: as health spending increases by NIS 1000 per resident, SRH decreases by 0.02% (precisely estimated zero effect).

Discussion and conclusion

This study examines whether joining the HCN affects the health of a city's residents. The HCN is considered a major intervention for health promotion around the world, making it important to measure how and whether membership in the

Table 1. Self-reported health (SRH) and municipal spending on health as dependent variables by network membership (using linear ordinary least squares regression with fixed effects).

Variable (SE)	Equation 1 *SRH*	*Equation 2 SRH*	*Equation 1 Health spending*	*Equation 2 Health spending*
Membership	–1.02 (0.90) [1.05]	–0.72 (0.91) [1.27]	–1483.78 (1445.42) [1038.92]	–723.28 (1494.40) [1081.35]
Membership* trend		0.19 (0.11)* [0.28]		366.43 (194.14)* [332.57]
Gender: female	0.06 (0.12) [0.15]	0.08 (0.12) [0.15]	42.31 (157.72) [138.92]	106.09 (159.57) [97.03]
Age 2 (45–64)	–0.54 (0.13)*** [0.12]***	–0.58 (0.13)*** [0.12]***	176.33 (173.46) [176.89]	63.30 (181.67) [80.53]
Age 3 (65+)	–0.57 (0.14)*** [0.17]***	–0.53 (0.14)*** [0.18]***	–280.56 (195.89) [311.41]	–259.39 (194.01) [276.22]
Jewish population	0.32 (0.07)*** [0.13]**	0.33 (0.07)*** [0.15]**	–157.38 (159.87) [251.37]	–129.19 (158.78) [215.86]
Religiosity: 2 Traditional Jewish	–0.11 (0.09) [0.14]	–0.08 (0.09) [0.12]	–372.12 (115.54)*** [277.54]	–345.91 (115.09)*** [238.40]
Religiosity: 3 Secular Jewish	0.08 (0.09) [0.11]	0.11(0.09) [0.10]	–347.14 (128.90)*** [269.79]	–340.68 (127.50)*** [240.48]
Education: 2 High school education	–0.06 (0.06) [0.05]	–0.06 (0.06) [0.07]	78.97 (84.08) [86.56]	79.66 (83.13) [72.56]
Education: 3 Academic education	–0.20 (0.08)** [0.09]**	–0.20 (0.08)** [0.08]**	127.69 (105.61) [105.65]	139.48 (104.61) [102.75]
Income 2 Monthly income: NIS 4001 or above	0.03 (0.05) [0.07]	0.03 (0.05) [0.07]	–228.74 (75.62)*** [193.52]	–237.10 (74.90)*** [175.54]
FE (year + city)	Yes	Yes	Yes	Yes
N	193	193	146	146
R-square	0.63	0.64	0.34	0.36

***$p < 0.01$.
**$p < 0.05$.
*$p < 0.1$. Standard errors in parentheses, bootstrapped standard errors in brackets.
SE: standard errors; FE: fixed effects; NIS: New Israeli Shekels.

Table 2. Self-reported health (SRH) and municipal health spending (using linear ordinary least squares regression with fixed effects).

Variable (SE)	*SRH*
Health budget	–0.0002 (0.0000)*** [0.0002]
Gender: female	0.06 (0.12) [0.13]
Age 2 (45–64)	–0.63 (0.14)*** [0.21]***
Age 3 (65+)	–0.65 (0.16)*** [0.19]***
Jewish population	0.06 (0.13) [0.13]
Religiosity: 2 Traditional Jewish	–0.13 (0.10) [0.12]
Religiosity: 3 Secular Jewish	0.05 (0.10) [0.11]
Education: 2 High school education	–0.07 (0.07) [0.08]
Education: 3 Academic education	–0.25 (0.08)*** [0.10]***
FE	Yes
N	146
R-square	0.67

***$p < 0.01$.
**$p < 0.05$.
*$p < 0.1$. Standard errors in parentheses, bootstrapped standard errors in brackets.
SE: standard errors; FE: fixed effects.

network indeed improves residents' health. However, variability between cities and the many process metrics involved in the intervention make it difficult to assess behavioral health metrics for participating cities (10,26).

Our results show that the entry of major cities into the HCN in Israel does not have an immediate effect on residents' SRH. However, network membership does have an effect over time, though this effect is only marginally statistically significant. Hence, SRH is positively associated with the number of years a city has participated in the network. SRH, also referred to as subjective health, has been consistently shown to be related to disease prevalence and is a predictor of mortality in many studies, including in Israel (27,28). Therefore, SRH is a strong measure of general wellbeing (28).

To assess the mechanisms by which HCN membership affects SRH, we investigated whether changes in municipal health spending are associated with years in the network, or directly with SRH. Network membership does not seem to immediately affect municipal health spending, but there is a mild increase in municipal health spending during network membership years. However, there is a negative association between spending on health and SRH. These results rule out the possibility that the improvements in SRH which follow network membership are mediated by better funding of health-promotion interventions.

Our findings raise three alternative possibilities. First, our model may not take into account variables that correlate with health budgets. Second, some municipal activities aimed at promoting health may be funded through non-health budgets, such as education and welfare (29), and thus may not formally result in increased health spending. This would prevent an accurate analysis of municipal activities directed towards health promotion. Finally, our findings may reflect reverse causality, where local authorities reduce the health budget in favor of more immediately urgent needs when they assume there is an increase in SRH.

Overall, this research establishes a link between years within the HCN and residents' wellbeing, as measured through SRH. However, the mechanisms behind this improvement – for example, improvements in health behaviors, health services or physical and social environments – remain opaque. Future research should investigate these possibilities while accounting for the scope of the health coordinator position, support of the mayor and council members, commitment of the steering committee and municipal health policy (7,23,27,30). We also suggest that future research would explore the link between the HCN and other health and

social indicators, such as social cohesion, improved collaborative services, which create conditions for people to be healthy, and the political system, among others.

What is already known on this subject?

The HCN aims to promote health and improve the quality of life and the environment in urban areas by engaging a broad range of stakeholders and residents. Studies show that the HCN has indeed engaged in activities to promote these issues; however, there is very limited information regarding effectiveness.

What does this study add?

The entry of major cities into the HCN in Israel improved residents' SRH over time. Network membership does not seem to affect municipal health spending, and there is a negative association between spending on health and SRH. Therefore, spending on health cannot explain the improvement of residents' SRH.

Declaration of conflicting interests

The authors have no conflicts of interest to declare.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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Notes

1. The UN's Agenda 21 is a non-binding action plan aimed at encouraging sustainable development (https://sustainabledevelopment.un.org/outcomedocuments/agenda21).
2. As noted above, data from the social survey are rich enough to be used at the city level only for the 13 largest cities in Israel. This data limitation restricts our analysis to these cities.
3. Most of our control variables are dummy variables (e.g. gender, age group). In case some dummy variables form a linear combination, we exclude one of them from the regression to avoid multicollinearity.
4. We note that when we correct the standard errors for heteroscedasticity this coefficient is no longer statistically significant.

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Appendix 1

Table 3. Summary statistics – explanatory and outcome variables.

Variable	*Max*	*Min*	*Average (standard deviation)*	*N*
Gender: male	54.8	39.4	(3.41) 47.73	208
Female	60.6	45.2	(2.18) 52.42	208
Age 1 (20–44)	66.3	39.4	(4.97) 50.5	208
Age 2 (45–64)	42.8	21.1	(3.14) 30.17	208
Age 3 (65+)	33.8	10.4	(3.84) 19.24	208
Jewish population	100	23	(9.11) 90.42	208
Arab population	87	0	(17.28) 18.78	37
Religiosity: Ultra-Orthodox Jewish	92	4	(22.53) 22.51	171
Traditional Jewish	62	6	(10.10) 40.08	199
Secular Jewish	71	6	(11.80) 43.27	194
Education: Did not finish high school	63.3	14	(9.20) 34.14	208
High school education	56.1	25.4	(5.63) 38.99	208
Academic education	49	6	(8.29) 27.37	203
Monthly income: NIS 4000 or below	89.7	13.7	(16.56) 52.76	208
NIS 4001 or above	79	10	(13.07) 31.13	203
Peripheral index	10	5	(1.56) 8.27	182
Socio-economic cluster	8	2	(1.58) 5.87	87
Population size	901,302	98,800	(175,712) 24,431.6	141
Self-reported health (outcome variable)	94.6	56.2	(6.63) 78.80	208
Health budget (outcome variable)	71209	199	(12,725.09) 7360.29	156

NIS: New Israeli Shekels.
All variables are in percentages, except for the peripheral index, the socio-economic cluster, population size and health budget, which is in 1000 NIS.