

How within-city socioeconomic disparities affect life expectancy? Results of Urban HEART in Tehran, Iran

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Abstract

Background: There is substantial lack of knowledge about the role of socioeconomic status (SES) indicators on life expectancy (LE) within-cities, especially within mega-cities. We aimed to investigate the disparities of LE within city districts of Tehran, Iran, and specify how SES inequalities play role on LE.

Methods: The death and population data for 2010 by different age, gender, and residency district were obtained from the main cemetery of Tehran and statistical centre of Iran, respectively. Age-specific mortality rates and consequently LE were calculated for all 22 districts by different genders. Finally, based on the results of first Tehran's Urban Health Equity Assessment and Response Tool (Urban HEART) project in 2008, the influence of social classes (SCs), total costs, and education indicators were analyzed on LE at birth (e0).

Results: The e0 for total males and females in Tehran were calculated as 74.6 and 78.4 years for 2010, respectively. The maximum LE of 80 years was observed in females of northern part with higher SES, and the minimum e0 of 72.7 years observed in males of southern part with lower SES. The e0 gender gap among districts was 5.5 years for females and 3.7 years for males. The highest and lowest mean of e0 observed in SC1 (highest class) and SC5 (lowest class), were 77.6 and 76.0 years, respectively. The lowest mean of e0 observed in the first group of total costs indicator and was 76.2 years. In addition, the lowest observed mean of e0 was in the first category of education indicator (illiterate) and was 76.0 years.

Conclusion: Results indicate substantial disparities in LE within city districts. This confirms that SES disparities within-cities would have direct influences on LE.

Keywords: Disparities, Education level, Expenditure, Inequality, Iran, Life expectancy, Longevity, Social class, Socioeconomic situation (SES), Tehran, Urban HEART, Within-city health metrics.

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Introduction

According to world health report 2000, disability-adjusted life expectancy (LE) at birth in Iran for 1999 was 60.5 years, and Iran had a rank of 96 among 191 member states of World Health Organization (WHO) (1). This was upgraded, moreover, to 71.56 years in 2003 (2), and in the most

recent report, life expectancy at birth increased to 73 years in 2009 (3).

Generally, there are considerable credible literatures that report influence of socioeconomic measures on LE (4-8). In brief, little association has been reported between LE and gross national product (GNP) among rich countries of the world (4).

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However, a potent relationship between socioeconomic status (SES) of the households and children mortality rates, exist within the country in which mortality rates increase gradually in households with lower SES (4, 9). In addition, education level has an inverse relation with mortality rates. For example, mortality rates have been reported to be less in well educated people of every parts of the world either developing or developed countries (9-13), where indicates the LE gap within educational groups is still rising to the extent that educational differentials may depict 30% of changes in LE (12). Nevertheless, albeit there is large body of literature in global- and national-scale on the influence of SES disparities on LE, considerable lack of knowledge exist on how SES factors play role on LE within-cities, especially within mega-cities.

In this study, the authors aimed a) to investigate the disparities of LE within 22 city-districts of Tehran, Iran, and b) to analyze the influence of SES disparities on LE within city-districts.

Methods

Study area

Tehran, the capital of Iran, is the largest and most populated city of the country. The population at the time of study was about 8.2 million people (14). The city has a large area of about 613 km², and divided administratively into 22 districts (15). The structure of the city is diverse in which socioeconomic situation of northern households are higher than southern parts.

LE calculations

In this analytic-descriptive study, we used census method to estimate LE within city districts. The main cemetery of Tehran, Behesht-e-Zahra which provides necessary service for family of deceased people is officially under subsidiary of Tehran Municipality where all death data are recorded. Thus, the number of deaths in 2010 obtained from this cemetery was based on age, gender, and residency district (16). The population data were also derived from

the statistical centre of Iran by the same categories (14). Age-specific mortality rates, thereafter, were calculated for all 22 districts of Tehran by different genders. Based on the age-specific mortality rates, the estimated LE for all Tehran's districts through various gender and age groups, were at birth or <1 year-old, 1-4, 5-9,..., 75-79, and >80 years-old. To estimate life tables we used MORTPAK 4 software—The United Nations Software Package for Mortality Measurements—with 17 different applications, using "COPMAR" and "MATCH" applications to estimate the LE (17). After determining the LE for all 22 districts, we plotted the results using geographic information system (GIS) to visualize the distribution of LE over the city districts.

Socioeconomic measures

In order to determine the influence of socioeconomic measures on LE within city districts, results of the first Tehran's Urban Health Equity Assessment and Response Tool (Urban HEART-1) project in 2008 were extracted (18). Briefly, the Tehran's Urban HEART project evaluated 42 indicators in six principal policy domains including "Physical and Infra-structure," "Human and Social Development," "Economic," "Governance," "Health" and "Nutrition" to quantify socioeconomic inequalities in a large population-based survey within Tehran megacity. In the current study, three indicators, namely "Socioeconomic Status (SES)" according to job, "Total Costs" (non-food), and "Education" were extracted and analyzed to explore the relationship with LE (18).

Social classes were determined according to the household head's occupation, and are summarized into six social classes (SCs).

Total Costs was a single quantitative variable, derived from a series of detailed questions regarding every aspect of household expenditures reported by the family head, which were finally categorized into five quintiles that represent 20 percent of total data for each category.

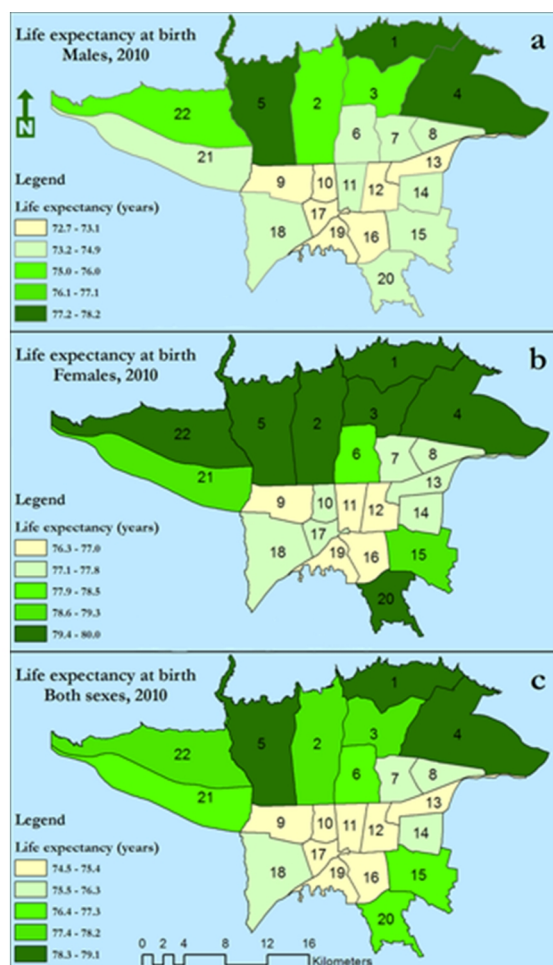


Fig. 1. Estimated distribution of life expectancy at birth for a) males, b) females and c) both genders in 22 districts of Tehran, Iran, 2010.

Education was categorized into five groups including “Illiterate,” “Primary,” “High-school and Diploma,” “Bachelor of Science (BSc) and under” and “Master of Science (MSc) and Higher.”

Statistical analyses

Kolmogorov-Smirnov test was used to test the normality of LE. Descriptive statistics were applied to SES, total costs, and education indicators. Levene's test was used to investigate the homogeneity (equality) of variances between sub-groups. Since the variances among the sub-groups were not equal, hence non-parametric tests were used. Moreover Kruskal-Wallis test was used to test differences between sub-groups and post-hoc test used for pairwise multiple comparisons between sub-groups.

Results

LE

The LE for total males and females in Tehran were calculated as 74.6 and 78.4 years for 2010, respectively ($p < 0.001$). The maximum LE of 80 years was observed in females of northern part (1, 4, and 5 districts) with higher socioeconomic status, and the minimum LE of 72.7 years observed in males of southern part (district 9) with lower socioeconomic status, and with a gap of 7.3 years (Fig. 1). The maximum and minimum observed LE for males in districts of northern (district 1) and southern part (district 9), were 78.2 and 72.7 years, respectively. The maximum LE for females estimated as 80 years in districts of northern part (districts of 1, 4, and 5), while the minimum was 76.3 years in district 9 in southern part. The LE gender gap among districts was 5.5 years for females and 3.7 for males. Regardless of gender difference, the maximum and minimum LEs observed in districts of northern (district 1) and southern part (district 9), were 79.1 and 74.5, respectively.

Table 1 shows LE at birth in all 22 districts of Tehran in both genders. Also, Ta-

Table 1. Life expectancy at birth within Tehran megacity by different districts, genders and geographic location

District	Males	Females	Both genders	Geographical location
1	78.2	80.0	79.1	North
2	75.9	79.6	77.7	North
3	75.9	79.5	77.7	North
4	78.0	80.0	79.0	North
5	77.8	80.0	78.9	North
6	74.7	78.4	76.5	South
7	74.2	77.7	75.9	South
8	74.0	77.3	75.6	West
9	72.7	76.3	74.5	South
10	73.1	77.1	75.1	South
11	73.7	77.0	75.3	South
12	72.8	76.7	74.7	South
13	73.1	77.7	75.4	West
14	74.3	77.6	75.9	West
15	74.7	78.6	76.6	South
16	72.9	76.4	74.6	South
17	72.8	77.2	75.0	South
18	74.0	77.5	75.7	South
19	73.0	76.8	74.9	South
20	74.0	79.9	76.9	South
21	74.0	79.1	76.5	East
22	75.6	79.7	77.6	East
Total	74.6	78.4	76.5	-

Table 2. Life expectancy of males in Tehran megacity by different districts and age-groups in 2010

Age group / District	1_4	5_9	10_14	15_19	20_24	25_29	30_34	35_39	40_44	45_49	50_54	55_59	60_64	65_69	70_74	75_79	80<
1	77.54	73.55	68.57	63.59	58.64	53.70	48.76	43.82	38.89	34.00	29.22	24.65	20.38	16.41	12.77	9.64	7.11
2	75.58	71.62	66.65	61.69	56.77	51.89	47.00	42.10	37.23	32.40	27.72	23.29	19.17	15.37	11.92	8.99	6.65
3	75.58	71.62	66.65	61.69	56.77	51.89	47.00	42.10	37.23	32.40	27.72	23.29	19.17	15.37	11.92	8.99	6.65
4	77.37	73.38	68.39	63.41	58.47	53.54	48.60	43.67	38.74	33.86	29.08	24.52	20.27	16.31	12.69	9.58	7.07
5	77.19	73.21	68.22	63.24	58.30	53.37	48.44	43.51	38.59	33.71	28.94	24.40	20.15	16.21	12.61	9.51	7.02
6	74.61	70.67	65.71	60.76	55.88	51.02	46.16	41.30	36.45	31.67	27.04	22.67	18.63	14.92	11.55	8.70	6.44
7	74.21	70.29	65.33	60.39	55.52	50.68	45.83	40.98	36.14	31.38	26.77	22.43	18.42	14.74	11.41	8.60	6.36
8	74.06	70.14	65.19	60.25	55.38	50.54	45.70	40.85	36.02	31.27	26.67	22.34	18.34	14.67	11.36	8.55	6.33
9	73.06	69.18	64.25	59.33	54.49	49.69	44.88	40.07	35.29	30.58	26.04	21.78	17.86	14.26	11.03	8.30	6.15
10	73.37	69.47	64.53	59.61	54.75	49.95	45.13	40.31	35.51	30.78	26.22	21.95	18.00	14.38	11.12	8.37	6.21
11	73.83	69.91	64.97	60.03	55.17	50.34	45.51	40.67	35.85	31.10	26.52	22.21	18.23	14.57	11.28	8.49	6.29
12	73.14	69.25	64.32	59.40	54.55	49.76	44.95	40.13	35.34	30.63	26.08	21.82	17.89	14.29	11.05	8.32	6.17
13	73.37	69.47	64.53	59.61	54.75	49.95	45.13	40.31	35.51	30.78	26.22	21.95	18.00	14.38	11.12	8.37	6.21
14	74.29	70.36	65.41	60.47	55.59	50.75	45.89	41.04	36.20	31.44	26.82	22.48	18.47	14.78	11.44	8.62	6.38
15	74.61	70.67	65.71	60.76	55.88	51.02	46.16	41.30	36.45	31.67	27.04	22.67	18.63	14.92	11.55	8.70	6.44
16	73.21	69.33	64.39	59.47	54.62	49.82	45.01	40.19	35.40	30.68	26.13	21.86	17.93	14.32	11.07	8.34	6.18
17	73.14	69.25	64.32	59.40	54.55	49.76	44.95	40.13	35.34	30.63	26.08	21.82	17.89	14.29	11.05	8.32	6.17
18	74.06	70.14	65.19	60.25	55.38	50.54	45.70	40.85	36.02	31.27	26.67	22.34	18.34	14.67	11.36	8.55	6.33
19	73.29	69.40	64.46	59.54	54.69	49.88	45.07	40.25	35.45	30.73	26.18	21.90	17.96	14.35	11.10	8.36	6.19
20	74.06	70.14	65.19	60.25	55.38	50.54	45.70	40.85	36.02	31.27	26.67	22.34	18.34	14.67	11.36	8.55	6.33
21	74.06	70.14	65.19	60.25	55.38	50.54	45.70	40.85	36.02	31.27	26.67	22.34	18.34	14.67	11.36	8.55	6.33
22	75.33	71.38	66.41	61.45	56.55	51.67	46.78	41.90	37.03	32.21	27.54	23.13	19.03	15.26	11.83	8.91	6.59
Total	74.53	70.59	65.63	60.69	55.80	50.95	46.09	41.23	36.39	31.61	26.98	22.62	18.59	14.88	11.53	8.68	6.43

bles 2 and 3 show LE of aforementioned age groups by different genders in all 22 districts of Tehran. Moreover, Figure 1 illustrates the geographic distribution of LE in all 22 districts of Tehran megacity by various genders. Descriptive statistics of SES, education, and total costs indicators, also, are shown in Table 4.

LE and SES

The highest and lowest mean of LE observed in SC1 and SC5, were 77.19 and 76.05 years, respectively. The variances between sub-groups of SES indicator were not equal ($p < 0.001$). Meanwhile, the mean of LE was significantly different in SES classes ($p < 0.001$). Notably, the mean of LE within the SC3b and SC4 was not different ($p > 0.1$).

LE and Total Costs

The lowest mean of LE was observed in the first group (percentile 20), with the lowest non-food costs, and calculated 76.20 years. The variances between sub-groups of total costs indicator were not equal ($p < 0.001$). Meanwhile, the mean of LE was

significantly different in total costs groups ($p < 0.001$).

LE and Education

The lowest observed mean of LE in the first category (illiterate), was 76 years. The variances between sub-groups of education indicator were not equal ($p < 0.001$). Meanwhile, the mean of LE was significantly different in education groups ($p < 0.001$).

Discussion

In this research, we studied intra-city differences for LE in Tehran mega-city. We further tried to visualize distribution of LE across 22 districts of Tehran for better understanding of associated changes in LE of general population. In addition, using results of Tehran's Urban HEART-1 project (18), the role of SES, total costs, and education disparities were characterized on LE within various districts. As a main result, substantial disparities were observed among LE of Tehran's 22 districts. As illustrated in Figure 1, the populations of the northern part districts, are most advantaged districts with higher SES, benefited with

Table 3. Life expectancy of females in Tehran megacity by different districts and age-groups in 2010

Age group / District	1_4	5_9	10_14	15_19	20_24	25_29	30_34	35_39	40_44	45_49	50_54	55_59	60_64	65_69	70_74	75_79	80<
1	79.57	75.60	70.62	65.63	60.66	55.69	50.73	45.78	40.86	35.97	31.18	26.49	21.90	17.50	13.42	9.87	6.98
2	79.23	75.27	70.29	65.31	60.34	55.38	50.42	45.48	40.56	35.69	30.91	26.24	21.67	17.30	13.26	9.76	6.91
3	79.15	75.19	70.21	65.23	60.26	55.30	50.35	45.41	40.49	35.62	30.85	26.18	21.62	17.25	13.22	9.73	6.89
4	79.57	75.60	70.62	65.63	60.66	55.69	50.73	45.78	40.86	35.97	31.18	26.49	21.90	17.50	13.42	9.87	6.98
5	79.57	75.60	70.62	65.63	60.66	55.69	50.73	45.78	40.86	35.97	31.18	26.49	21.90	17.50	13.42	9.87	6.98
6	78.26	74.32	69.35	64.38	59.42	54.48	49.54	44.62	39.73	34.89	30.16	25.54	21.04	16.75	12.82	9.43	6.70
7	77.70	73.78	68.82	63.85	58.90	53.97	49.05	44.14	39.27	34.46	29.75	25.16	20.70	16.46	12.58	9.26	6.59
8	77.38	73.48	68.52	63.56	58.61	53.69	48.77	43.88	39.02	34.21	29.52	24.95	20.51	16.30	12.45	9.17	6.53
9	76.61	72.74	67.80	62.84	57.92	53.01	48.12	43.24	38.41	33.64	28.98	24.46	20.07	15.92	12.15	8.95	6.39
10	77.23	73.33	68.38	63.41	58.47	53.55	48.64	43.75	38.89	34.10	29.41	24.85	20.42	16.22	12.39	9.12	6.50
11	77.15	73.26	68.30	63.34	58.40	53.48	48.57	43.68	38.83	34.04	29.35	24.80	20.38	16.18	12.36	9.10	6.48
12	76.92	73.04	68.08	63.13	58.19	53.28	48.38	43.49	38.65	33.86	29.19	24.65	20.24	16.07	12.27	9.03	6.44
13	77.70	73.78	68.82	63.85	58.90	53.97	49.05	44.14	39.27	34.46	29.75	25.16	20.70	16.46	12.58	9.26	6.59
14	77.62	73.71	68.74	63.78	58.83	53.90	48.98	44.07	39.21	34.39	29.69	25.11	20.65	16.42	12.55	9.24	6.57
15	78.42	74.48	69.50	64.53	59.57	54.62	49.68	44.76	39.86	35.02	30.28	25.65	21.14	16.84	12.89	9.48	6.73
16	76.69	72.82	67.87	62.91	57.98	53.08	48.18	43.30	38.47	33.69	29.03	24.50	20.11	15.96	12.18	8.97	6.40
17	77.31	73.41	68.45	63.49	58.54	53.62	48.71	43.81	38.95	34.15	29.46	24.90	20.47	16.26	12.42	9.14	6.51
18	77.54	73.63	68.67	63.70	58.76	53.83	48.91	44.01	39.14	34.33	29.63	25.05	20.60	16.38	12.52	9.21	6.56
19	76.99	73.11	68.16	63.20	58.26	53.35	48.44	43.56	38.71	33.92	29.25	24.70	20.29	16.11	12.30	9.05	6.46
20	79.48	75.52	70.53	65.55	60.58	55.61	50.65	45.71	40.78	35.90	31.11	26.42	21.84	17.45	13.38	9.84	6.97
21	78.82	74.87	69.89	64.92	59.95	55.00	50.05	45.11	40.21	35.35	30.59	25.94	21.40	17.06	13.07	9.62	6.82
22	79.32	75.35	70.37	65.39	60.42	55.46	50.50	45.56	40.64	35.76	30.98	26.30	21.73	17.35	13.30	9.79	6.93
Total	78.26	74.32	69.35	64.38	59.42	54.48	49.54	44.62	39.73	34.89	30.16	25.54	21.04	16.75	12.82	9.43	6.70

more LE compared to southern districts. Meanwhile, the maximum LE was 80 years in females living in north and minimum 72.7 years in males of southern parts which indicate that socioeconomic inequalities within cities could have direct influence on LE within Tehran population.

This is the first report of direct calculation of life expectancy using registered data in Tehran, which inturn correlated with contextual ecologic data of households living in different districts. In previous study, Fereshtehnejad et al. (2010) reported an estimation of LE using a large population sample, which indicated that LE was largely influenced by contextual variables, such as level of education, family size, household expenditures, and social class (19).

Although the influences of various variables of socioeconomic position (20-24), GNP (25), and education level (12-13, 26), on LE have been studied in global and national-scales among populations of countries and states, there are few reports that study these relations within city populations (9). For example, a study in Philadelphia demonstrated that child mortality rate (CMR) in 1971 was 22-per-thousands while at the same time the gap for CMR in two different districts was 18-per-thousands

(27). Haan et al., (1987), also, studied white and non-white residents of two federally specified impoverished and advantaged areas of Oakland, Alameda, California for nine-years from 1965 to 1974, and reported that both resident groups of poor areas experienced significantly higher mortalities versus well-off areas (28). McCord and Freeman (1990) studied male residents of Central Harlem health district in New York City, where 41 percent were below the poverty line and predominantly black. They reported an extremely high mortality for them identical or less to rural males of less developed countries (29). Geronimus et al., (1996) studied residents of sixteen persistent poor and affluent areas of different cities in the United States, where the mortality rates of black males (i.e., in Harlem) were escalated compared to advantaged residential places (30). Guest et al., (1998) studied 308 populations of Chicago (77 community areas by gender and by two ethnicities) and estimated their mortality rates. In fact, they have found consistent results with McCord and Freeman (1990) in which mortality rates of black males were three-fold more than non-black males and six-fold more than non-black females (31). Thus, mortality rates and LE have been reported to be

Table 4. Ecological relationship between life expectancy and social classes, level of education, and family expenditures

Main variable	Subgroups	Mean (SD)	p-value
Social class	SC-1	77.19 (1.42)	<0.001
	SC-2	76.74 (1.50)	
	SC-3a	76.51 (1.50)	
	SC-3b	76.28 (1.44)	
	SC-4	76.32 (1.45)	
	SC-5	76.05 (1.36)	
	Total	76.48 (1.47)	
Education	Illiterate	76.00 (1.34)	<0.001
	Primary	76.17 (1.39)	
	High-school and Diploma	76.46 (1.48)	
	Bachelor of Science and Under	76.98 (1.49)	
	Master of Science and Higher	77.38 (1.39)	
	Total	76.47 (1.49)	
Household costs	First quintile (20%)	76.20 (1.39)	<0.001
	Second quintile (40%)	76.30 (1.44)	
	Third quintile (60%)	76.45 (1.48)	
	Fourth quintile (80%)	76.61 (1.53)	
	Fifth quintile (100%)	76.91 (1.55)	
	Total	76.50 (1.50)	

quite different within city areas.

In essence, extensive national- and regional-scale studies have studied the role of different socioeconomic and sociodemographic status measures on longevity and life expectancy (9, 24, 32-35). Kulkarni et al., (2011) studied LE disparities across United States counties and found a considerable gap of 15.2 and 12.5 years for men and women, respectively (24). Clarke et al., (2010) reported a substantial impact of neighborhood SES among different age, genders, and ethnicities on LE. They have found that those males of California, which are in the poorest 20% neighborhoods, have the same LE as males of those developing countries that low LEs have been reported for them (32). In another report among general population by Tarkiainen et al., (2012), the role of Finnish people's income was studied on LE over 20 years. Noteworthy, a gap of LE by 5.1 years among males and 2.9 years among females was observed within maximum and minimum income quintiles (34). Tobias and Cheung (2003), also, studied three ethnicities (i.e., Māori, Pacific, and European) of New Zealand within four periods from 1995 to 2000, and

analyzed LE with increasing/decreasing of deprivation in small areas. Thus, they found a strong association between LE and deprivation, in which longevity of males living in rich areas was nine-years more than their counterparts in deprived areas (36). Besides, a negative correlation between education level of the people and life expectancy has been reported in Bangladesh and Norwegian territories in which educated people have higher longevity (9, 33). Identically, an inverse relationship between education level of the people and longevity has been reported from the United States in which higher mortality rates have been reported for poorly educated people compared with those benefited from better education (37).

Limitations

The first limitation of this study was due to high and unpredictable rate of migration and relocation among the districts. This might have changed somewhat the amount of calculated LEs. The second limitation was ecologic design of the study, which harbored some inherent weaknesses. In fact, ecologic studies suffer from effect of a

variety of confounding factors. The third limitation which highlighted specifically in developing countries as well as Iran was mortality registration. The mortality system of record in developing countries suffers from some weaknesses, especially in lower age groups like those with fewer than one year old. This problem might also affect the amount of calculated LEs. However, although the resulted were affected by these limitations, we believe there are considerable validities within these data.

Conclusion

Our findings highlight the inequalities in life expectancy across districts of a megacity, in particular the SES differentials of LE. This study demonstrated that LE had important different within city districts, especially within mega-cities. These inequalities, in fact, underline the importance of resources management within specific regions of the cities—to enhance the quality of life as well as the LE of populations. Meanwhile, LE may be influenced by different factors, such as socioeconomic position, and variations of LE within city districts can be a mirror of inequalities. Nonetheless the results of this study may pave the way for health policy makers, urban planners and health professionals to think more about socioeconomic determinants of this important outcome of health status.

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Finally, the authors declare that they have no conflict of interest.

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