Current status of health index in Tehran: A multidimensional approach

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Abstract

  Background: Health is an essential component of human rights and the rights are interdependent, indivisible, and correlated. The present study aimed at codifying a multidimensional health index according to multistage index development and describing the status of this index in 22 municipal districts of Tehran.

  Methods: This study was conducted using the data collected in the second round of Urban HEART Project of Tehran (2012-2013). The sample size was 34 700. To develop a multidimensional health index (MDHI), the nine steps of the Organization for Economic Cooperation and Development (OECD) were followed, from codifying theoretical framework to introducing the index.

  Results: According to the constructed MDHI, the districts no. 13, 10, 17, 1, 3, 4, and 22 had the best status and the district no. 8 the worst status. With respect to physical health, the districts no. 13, 17, 1, 3, 10, and 18 had the best status and the district no. 8 the worst. Concerning mental health, the districts no. 3, 6, 1, and 10 had the best status and the districts no. 8 and 12 the worst status. With respect to social health, the districts no. 10, 22, and 21 had the best status and the districts no. 6, 7, 12, and 14 the worst status. The analysis of sensitivity indicated that the MDHI was more sensitive towards physical health. Based on the mean, minimum, and maximum scores on each indicator of the questionnaires, the physical, mental, social, and MDHI status of Tehran residents (2012-2013) was high-medium, medium, low-medium, and high-medium, respectively.

  Conclusion: The right to health should be widely investigated, as it is a primary principle needed for sustainable development, which can be accomplished when the attitudes of different organizations towards the health construct are multidimensional rather than unidimensional.

  Keywords: Multidimensional Health, Mental Health, Social Health, Physical Health

Introduction

Health is an essential component of human rights and understanding and recognition of a dignified life. The WHO Constitution states that enjoying the highest attainable standard of health is an essential component of every human being's right, regardless of his/her race, religion, political beliefs, and socioeconomic status (1). Since human rights are interdependent, indivisible, and correlated, violation of the right to health may affect the enjoyment of other human rights such as the right to education and work (2). Health, wellbeing, and development are directly correlated (3).

WHO defined health as "complete physical, mental, and social wellbeing and not merely the absence of disease"(1). Besides that, Hjelm considered physical, emo-

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↑What is "already known" in this topic:
As WHO and other international organizations have stated, health is a multidimensional index, but it has been measured only by 1 dimension.

→What this article adds:
Based on WHO definition of health and OECD manual, health status is measured by several steps. Measuring health status as a multidimensional index calls for inter-organizational corporation.

tional, social, spiritual, and emotional dimensions for health and offered a holistic concept of health (4). Ziebarth has classified health measures into subjective, objective, general, and individual judgement-based (5). In different studies conducted on general and special populations, health has been measured and assessed by different scales (4) as follow: Eberst health six-dimensional scale, consisting of physical, emotional, psychological, social, mental, and vocational dimensions) (6); Duke-UNC Health Profile (DUHP), consisting of 4 dimensions of symptom status, physical function, emotional function, and social function (7); the four-dimensional Duke Health Profile, including physical, social, mental and public; the Nottingham Health Profile (NHP), consisting of 6 dimensions: energy, sleep, pain, emotional reactions, social isolation, and physical mobility (8); twelve-dimensional disease profile and the profile of functional limitations; three-dimensional index of health (with dimensions of physical function, emotional function, and social function (2); Karoly et al's multidimensional health index, including health history, health habits, the efficiency of health care, beliefs and attitudes to health, and response to disease (9); Quality of Life SF-36 (10); and Human Development Index (11). However, after searching the main databases such as PubMed (especially MeSH), Scopus, Web of Sciences, Google Scholar, the Persian database of SID etc. We could not find any empirical study on multidimensional health.

Unidimensional and multidimensional scales may provide completely different information to planners and policymakers when used to measure any constructs including health (12,13). Monitoring the changes in health status at population level is an advantage of measuring health in different time periods and locations, because monitoring may reveal that to what extent policies, plans, and practices have achieved the goals set for them. Therefore, different national and international projects have already been conducted. One of these projects is Urban HEART. This project was launched with the collaboration of national and urban policymakers, researchers, and academicians, international entities, and the WHO in 2007. According to the Urban HEART, as a guideline, and by means of the framework of social determinants of health (SDH), local and national stakeholders determine, prioritize, and follow up the inequalities in 6 areas of environmental and physical infrastructure, social and human development, economy, governance, health, and nutrition using a process and offer a range of strategies to reduce the inequalities (14). The Urban HEART was developed between 2007 and 2010, then piloted in 17 cities in 9 countries, and it is currently being implemented in 40 countries. Some countries such as Canada, Colombia, Indonesia, Iran, the Philippines, and Sri Lanka have volunteered to implement the Urban HEART (15). In Tehran, capital of Iran, the Urban HEART was implemented twice (in 2009 and 2012) on a large population in all 22 municipal districts to determine the SDH inequalities inside and among the municipal districts.

Tehran has a population of over 12 million (approximately 16.2% of the national population), with an average annual growth of 1.5%. According to the Development Perspective Document, 7 causes have been set for Tehran; namely, greenery and freshness, public wellbeing, and appropriate infrastructure accompanied with adjusting inequalities, ensuring all civil rights fairly, and converting to at least one of the 3 main cities of south Asia. Thus, considering the significance of measuring health to develop evidence-based interventions, the present study aimed at codifying a multidimensional health index (MDHI) according to the multistage index development (12) and describing the status of this index in 22 municipal districts of Tehran.

Methods
Data
The present study was conducted using the data collected in the second round of Urban Justice Measurement Project of Tehran (2012-2013). In that project, multistage sampling was done separately in the municipal districts (n= 22) and neighborhoods (n= 368) according to stratified, clustering, and systematic methods (16). As this study measured the health of the selected people multidimensionally, the sample size was considered to be 34 700 participants.

Instruments
In the Urban Justice Measurement Project of Tehran (the second round), the data were collected by the 3 following questionnaires: (1) Family General Questionnaire, including demographic characteristics, socioeconomic status, accidents, violence, disability, substance abuse, household costs information, and food security; (2) the Questionnaire of Selected Member of Family, including GHQ-28, social capital, and quality of life items; and (3) Family Nutrition Questionnaire. In the present study, the data were drawn from number 1 and 2 questionnaires.

Stages of Index Development
To develop a multidimensional health index, we used the 9 stages of OECD (12,19), which were as follow: (1) codifying theoretical framework, defining concepts, and subpopulations; (2) selecting variables; (3) replacing missing data; (4) multivariate analysis; (5) developing index; (6) weighting and aggregation; (7) sensitivity analysis; (8) finding an association with other variables; and (9) introducing and publicizing the index.

Stage 1. Codifying Theoretical Framework and Defining Concepts and Subpopulations: In the light of theoretical fundamentals and previous studies on health, this study considered the WHO's definition as the theoretical framework of multidimensional health index. Furthermore, 3 dimensions (physical, social, and mental) were considered as dimensions of health.

Stage 2. Selecting the Variables: To select and investigate the input variables meticulously in codifying the multidimensional health index, 2 expert panels were formed by a number of experts on community medicine, psychiatry, health, and social wellbeing. Finally, 12 indicators were identified and considered for analysis (Table 1). Oral health was operationalized by 4 variables (Table 2). In addition, the number of maxillary and mandibular teeth

Table 1. Indicators and Dimensions of Multidimensional Health Index and Their Sources

Health Dimensions	Indicators	The Operationalization of the Indicators
Mental dimension	Depression	28-item GHQ
	Anxiety and insomnia	28-item GHQ
	Somatization	28-item GHQ
	Pathogenic dysfunction	Quality of life questionnaire
Social dimension	Social participation	Social capital questionnaire
	Attitude towards community	Social capital questionnaire
	Social dysfunction	28-item GHQ
	Social relationships	Social capital questionnaire
	Oral health	See Table 2
Physical dimension	Weight and mobility	BMI and quality of life questionnaire
	Physical pain	Back, neck, shoulders, knees, upper limbs except the shoulders, lower limbs except the knees
	The burden of chronic diseases*	Diabetes, hypertension, osteoporosis, asthma, heart attack, stroke and cancer

* Due to lack of access to data at the individual level, the data were analyzed at the neighborhood level.

Table 2. The Operationalization of Oral Health

The number of maxillary and mandibular teeth (2 variables):
The minimum and maximum number of teeth is 0 and 32, respectively. These 2 variables were converted into ordinal variables as follow:
No teeth (Code 1), 1 to 15 teeth (2), 16 to 25 teeth (3), 26 to 32 teeth (4)
Individual assessment of oral health (ordinal variable):
Terrible (Code 1), bad (2), average (3), good (4), very good (5)
The dissatisfaction level with the teeth appearance and irregularity (ordinal variable):
Never (Code 4), sometimes (3), most of the time (2), always (1)

was converted into the classification that has already been offered by a similar study (17).

Stage 3. Replacing Missing Data: In this step, linear interpolation was individually used for the variables. To control the lack of variation in the distribution of new (with no missing data) and old (with missing data) variables, the correlation coefficient between the 2 variables was calculated. The correlation coefficient 1 represented no variation in the distribution of the initial variable. In other words, we calculated the correlation between the 2 variables to find whether the new variable derived from replacing the missing data had a similar distribution to that of the initial variable.

Stage 4. Multivariate Analysis: Taking into account the viewpoints of experts, theoretical fundamentals, and definitions of health and considering the limited data gathered, we used the analysis of main parameters (exploratory factor analysis) with oblimin rotation to reduce the questions. This analysis was conducted in first and second orders.

In the first-order factor analysis, 11 components were identified, which explained approximately 60% of the total variance. Furthermore, in the second-order factor analysis, conducted by the scores of 11 components drawn in the first-order factor analysis, 3 components were drawn, which explained approximately 44.57% of the total variance (Table 3).

The results of investigating the burden of chronic diseases are presented in Table 4. As demonstrated, 7 chronic diseases were loaded on a component with 64.47% variance. The factor burden of chronic diseases is an indicator of physical dimension of multidimensional health index.

Stage 5. Developing Index: In the light of the drawn factors and the questions loaded on each factor, 3 health dimensions (physical, mental, and social) were operationalized. For this purpose, Equation 1 was used to reverse the variables' direction from negative into positive, Equation 2 to convert the scale of the variables (the indicators of each health dimension) into a score between 0 and 1, and Equation 3 to calculate the multidimensional health index according to the technical guideline of Human Development Index (11).

Table 3. The components drawn from the second-order factor analysis and the loaded first-order factors on them in the second-order factor analysis

Second-Order Factor	First-Order Factor	Components Factor Loadings		
		First	Second	Third
Mental health	Depression	0.746		
	Anxiety and insomnia	0.732		
	Physical problems	0.684		
	Pathogenic dysfunction	0.552		
Social health	Social participation		0.636	
	Attitude to community		0.627	
	Social activity		0.544	
	Social relationships		0.521	
Physical health	Oral health			0.670
	Weight and mobility			0.607
	Physical pain			0.581

First- Order EFA: KMO = 0.913, $X^2(1275) = 100501.85$, p<0.001, total variance = 60%.
Second- Order EFA: KMO = 0.721, $X^2(55) = 4261.7$, p<0.001, total variance = 44.57%.

Table 4. The Factor Load of the Variables Loaded on the Burden of Chronic Diseases at the Neighborhood Level

Component	Disease	Factor loadings
The burden of chronic diseases	Diabetes	0.873
	Hypertension	0.808
	Osteoporosis	0.908
	Asthma	0.933
	Myocardial infarction	0.858
	Stroke	0.671
	Cancer	0.465

KMO = 0.804, $X^2(21) = 95.29$, p<0.001, total variance= 64.47%.

$$Re\,versedVariable = Max - Min - Old\,.Variable \qquad (1)$$

$$PositiveVariable = \frac{Old.Variable - Min}{Max - Min} \qquad (2)$$

$$MDHI = (I_{Physical} \times I_{Mental} \times I_{Social})^{\frac{1}{3}} \qquad (3)$$

In Equation 3, MDHI represents the multidimensional health index, and the parenthetical items stand for physical, mental, and social indices of health.

Stage 6. Weighting and Aggregation: To aggregate the 3 health dimensions of the combined index, the technical guideline of Human Development Index (i.e. the geometric mean calculated by Equation 3) was used (11). The results of index aggregation are presented in Table 5.

Stage 7. Sensitivity Analysis: To investigate the sensitivity of multidimensional health index to individual dimensions, different weightings were used for different dimensions, which are as follow:

Weighting according to the guideline of Human Development Index; Weighting according to the viewpoints of 18 experts on different subdisciplines of health including health and social wellbeing, health economy, health education, nursing, clinical psychology, administration of healthcare services, mental health, epidemiology, health in disasters and emergencies, social health determinants, health policymaking, and psychiatry; equal weighting; and different weighting according to the decision of the research team (Table 6).

Stage 8. Association with Other Variables: Combined indices often measure the concepts that are associated with other measurable and known phenomena, for exam-

ple, gross domestic product and economic growth.

Such associations can be used to test the explanatory power of a combined index. In this study, 2 health indices (physical and mental) were used to investigate the association of the multidimensional health index and each one of its dimensions with other variables of the same level in other studies. These 2 indices have been studied by Tehran Urban Research and Planning Center (2013-2014) in Tehran Metropolitan and separately in 22 municipal districts on a population of 10 000.

Stage 9. Introducing and Publicizing Multidimensional Health Index: The aggregately and dimension-sensitively calculated indices are displayed in Table 7, GIS maps of each index, and 22 districts.

Results

The scores of the individual dimensions and multidimensional health index of 22 municipal districts of Tehran were derived according to the 9 above-mentioned stages, the tables of the indicators of health dimensions (Table 1), and the Equations 1 to 3 (Table 5).

The analysis of sensitivity of multidimensional health index indicated that in equal weighting, the lowest score was obtained for the social dimension and in greater weighting, the highest score for physical dimension. In other words, the highest proportion of index growth was observed when the physical dimension obtained a greater weight. As a result, the multidimensional health index was more sensitive to the physical health (Table 6).

With respect to the association of multidimensional health index and individual dimensions with other indices in other studies, the physical dimension calculated in this study and physical health (18) (r= 0.202, p= 0.21, n= 22), and mental health (18) (r= 0.316, p= 0.15, n= 22) were positively correlated in 2012; the mental dimension calcu-

Table 5. Descriptive indices of the dimensions and the total score of multidimensional health index in Tehran

Dimensions	N	Mean	SD	Min	Max	RASD**
Physical	22	3.15	0.268	2.66	3.71	0-5
Mental	22	2.48	0.073	2.36	2.63	0-4
Social	22	1.75	0.046	1.67	1.84	0-4
MDHI*	22	7.41	0.296	6.93	7.98	0-13

* Based on the guideline of Human Development Index (Equation 3)
**The range of attainable score in each dimension

Table 6. The results of sensitivity analysis with different weights of health dimensions

Index	Weight Table	Mean Index	Change (%)
	[Physical_{per.Lev,} Mental_{per.L}, Social_{per.L}]		
Equal weighting	[1/3, 1/3, 1/3]	2.47	--
Experts' viewpoints*	[0.36, 0.33, 0.31]	2.50	+1
Greater weighting of physical dimension	[0.50, 0.25, 0.25]	2.64	+6
Greater weighting of mental dimension	[0.25, 0.50, 0.25]	2.48	+0.4
Greater weighting of social dimension	[0.25, 0.25, 0.50]	2.29	-7.3

* This index was weighted according to the viewpoints of 18 experts on different areas of health.
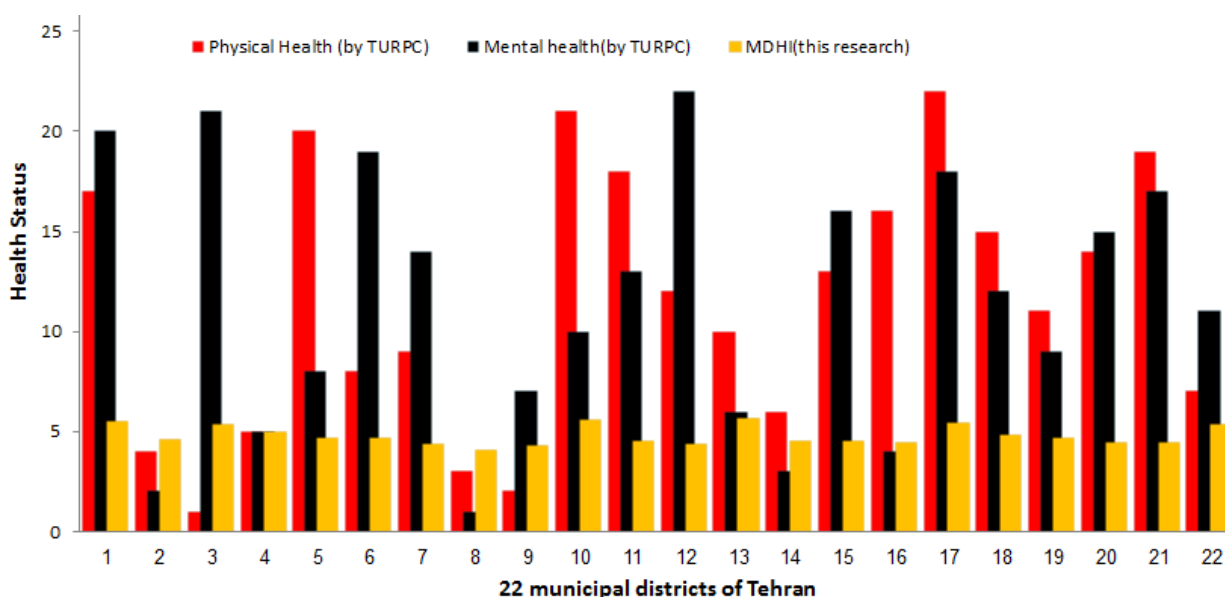
Fig. 1. The Status of Multidimensional Health Index of the Present Study and the Indices of Physical and Mental Health of Tehran Urban Research and Planning Center in 2012

lated in this study and mental health (18) (r= 0.204, p=0.36, n= 22), and physical health (18) (r= 0.202, p=0.36, n= 22) were positively correlated in 2012; the social dimension calculated in this study and physical health (18) (r= 0.163, p= 0.46, n= 22), and mental health (18) (r=0.106, p= 0.63, n= 22) were positively correlated in 2012; and finally, the multidimensional health index calculated in this study and physical health (18) (r= 0.240, p=0.28, n= 22), and mental health (18) (r= 0.163, p= 0.46, n= 22) were positively correlated in 2012 (Figure 1).

Introducing and publicizing the index was the Stage 9 of the index development. Regarding the 3 indicators and multidimensional health index described above, the status of 22 municipal districts of Tehran is presented in Table 7 and illustrated only by MDHI in Figure 2. The darker col-

ors in the figure and higher scores of individual dimensions and multidimensional health index represent better health status.

Based on the data of Table 7 and GIS maps, the districts no. 13, 10, 17, 1, 3, 4, and 22 had the best multidimensional health index and the district no. 8 the worst multidimensional health index. With respect to physical health, the districts no. 13, 17, 1, 3, 10, and 18 had the best status and the district no. 8 the worst. Regarding mental health, the districts no. 3, 6, 1, and 10 had the best status and the districts no. 8 and 12 the worst. Concerning t social health, the districts no. 10, 22, and 21 had the best status and the districts no. 6, 7, 12, and 14 the worst.

Discussion and Conclusion

In the present study, the health status of Tehran was investigated based on the WHO definition of health (physical, mental, and social dimensions). Each dimension was conceptualized and operationalized by 4 indicators. According to the findings of first- and second-order factor analysis, 60% and 44.5% of the total variance was explained, respectively. The burden of chronic diseases was investigated at neighborhood level because of the aggregated data and explained approximately 64.4% of the total variance. In the light of the findings, according to the multidimensional health status, the health status of 10 districts was moderate to very high and that of 1 district (no. 8) very low; with respect to physical health, 9 districts had moderate to very high status and 1 district (no. 8) very low status. Regarding mental health, 10 districts had moderate to very high status and 2 districts (no. 12 and 18) very low status; and concerning social health, 9 districts had moderate to very high status and 4 districts (no. 6, 7, 12, and 14) very low status. The difference in health status among different districts could be attributed to various reasons including population density, green space, parks and entertainment facilities per capita, urban beautification, vari-

Table 7. The status of Tehran 22 municipal districts based on separate dimensions of health and multidimensional health index

| Zones	MDHI	Physical	Mental	Social
1	7.83	3.44	2.58	1.75
2	7.27	2.98	2.53	1.74
3	7.77	3.39	2.62	1.77
4	7.56	3.28	2.51	1.77
5	7.35	3.03	2.51	1.72
6	7.42	3.08	2.63	1.67
7	7.20	2.97	2.54	1.69
8	6.93	2.66	2.48	1.75
9	7.09	2.85	2.46	1.74
10	7.84	3.44	2.56	1.84
11	7.24	3.03	2.43	1.73
12	7.26	3.19	2.36	1.67
13	7.98	3.67	2.47	1.77
14	7.27	3.07	2.41	1.69
15	7.25	3.05	2.42	1.76
16	7.19	2.95	2.42	1.74
17	7.93	3.71	2.46	1.75
18	7.49	3.35	2.38	1.76
19	7.32	3.10	2.41	1.78
20	7.17	2.86	2.49	1.78
21	7.19	2.90	2.46	1.81
22	7.67	3.31	2.51	1.84
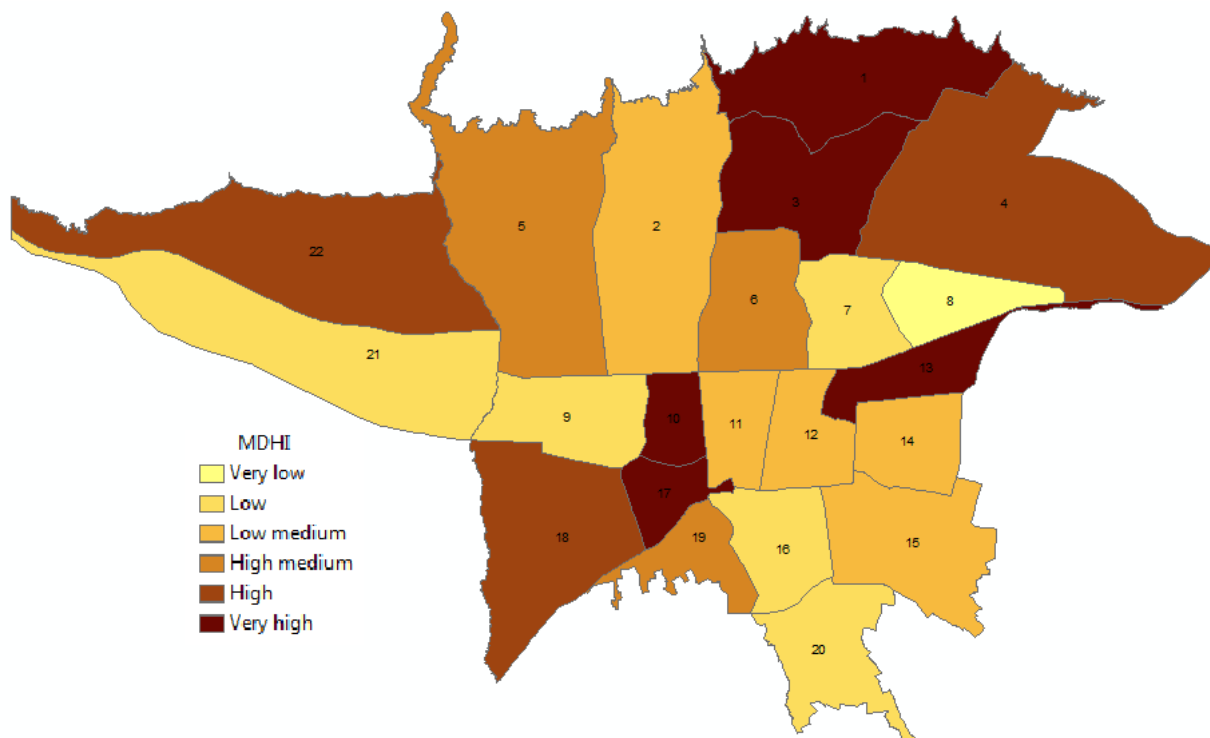
Fig. 2. Tehran municipal districts based on multidimensional health index

ous facilities of leisure time, transportation, air pollution, and socioeconomic security. The descriptive indices have indicated that the physical health status of Tehran citizens is more favorable than their mental and social health status. The categorization of 22 municipal districts of Tehran into 6 classes demonstrated that according to the physical, mental, and social dimensions, districts 1, 2, and 4 had a low health status, respectively.

Although the data gathered in this study were limited, health was measured both objectively and subjectively because the multidimensional health measurement offered by OECD (12) was adopted. The use of a single database was another advantage of this measurement, which helped to improve a valid scale (The correlation coefficients between this index and other indices calculated in other studies were calculated.).

About half a century ago, the WHO defined health as a multidimensional construct. However, not only a unidimensional perspective is still being considered in measuring health status but also biomedical perspective is mainly supported, and other dimensions are frequently disregarded in measuring citizens' health. Furthermore, there is no consensus on measurement of health as a multidimensional phenomenon among theorists and policymakers. The findings presented in this study indicated that any one of the 3 dimensions of health represented a different health profile in Tehran. This finding emphasizes that multidimensional indices should be used in measuring urban health to improve the validity of measures as much as possible, as various items are used to measure a condition such as depression. The findings of the present study can be used to change the attitude of health policymakers in measuring health and assist these policymakers in large

and costly projects implemented for measuring health status.

Although the right to health is considered a fundamental constituent of human rights, international declarations and conventions emphasize the fulfillment of the right to health. The WHO, the only specialized and active health-related organization, has defined health as a multidimensional construct. However, few studies have considered health as a multidimensional construct to date such that few publications can be retrieved from the databases using the term "multidimensional health". The right to health should be widely investigated, as it is a primary principle needed for sustainable development. This can be accomplished if the attitudes of different organizations towards the health construct are multidimensional rather than unidimensional. The Urban HEART is a successful project in a limited number of countries. The adoption of this project by other countries could be considered as an important basis for multidimensional measurement of health and multidimensional comparison of health among all the countries across the world.

Acknowledgments

Conflict of Interests

The authors declare that they have no competing interests.

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