RESEARCH COMMUNICATION

Measuring Socioeconomic Disparities in Cancer Incidence in Tehran, 2008

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Abstract

Background: Health disparities exist among and within countries, while developing and low income countries suffer more. The aim of this study was to quantify cancer disparities with regard to socioeconomic position (SEP) in 22 districts of Tehran, Iran. Method: According to the national cancer registry, 7599 new cancer cases were recorded within 22 districts of Tehran in 2008. Based on combined data from census and a population-based health equity study (Urban HEART), socioeconomic position (SEP) was calculated for each district. Index of disparity, absolute and relative concentration indices (ACI & RCI) were used for measuring disparities in cancer incidence. Results: The overall cancer age standardised rate (ASR) was 117.2 per 100,000 individuals (120.4 for men and 113.5 for women). Maximum ASR in both genders was seen in districts 6, 3, 1 and 2. Breast, colorectal, stomach, skin and prostate were the most common cancers. Districts with higher SEP had higher ASR (r=0.9, p<0.001). Positive ACI and RCI indicated that cancer cases accumulated in districts with high SEP. Female disparity was greater than for men in all measures. Breast, colorectal, prostate and bladder ASR ascended across SEP groups. Negative ACI and RCI in cervical and skin cancers in women indicate their aggregation in lower SEP groups. Breast cancer had the highest absolute disparities measure. Conclusion: This report provides an appropriate guide and new evidence on disparities across geographical, demographic and particular SEP groups. Higher ASR in specific districts warrants further research to investigate the background predisposing factors.

Keywords: Cancer incidence - socioeconomic disparity - ASR - geographical information system - Tehran, Iran

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Introduction

Health disparities exist between and within countries albeit health status at national and global levels may have become better (Mackenbach et al., 2008; Smits and Monden, 2009). Reducing health inequalities as an approach to the newly announced global target 'health for all, all for equity', is mandatory for public health purposes. Geographical settings are a potential source of disparity and risk. (Rosenberg and Wilson, 2000; Tobias and Searle, 2006; Bernard et al., 2007). Health and social inequalities can be measured across subgroups of the population, which may be stemmed in biological, social, environmental or geographical characteristics (Murray et al., 1999). Socio-economic characteristics such as asset, income, education, occupation, racial group, residence type are potential indicators to compare different groups according to their associations with social and health attributes (Braveman et al., 2001; Natale-Pereira et al., 2011). Health indicators are summary measures of the population subgroups to show inequalities, besides they provide insights into causal pathways of socioeconomic determinants of health (SDH) (Murray et al., 1999). Difference between geographical areas reflects social characteristics, which may ease the perception of ill-health distribution (Kaplan, 1996).

Many studies have shown that morbidity and also cancer incidence are accumulated in lower socioeconomic groups and cancer indicators assert significant differences not only between countries but also between and even within cities (Yiengprugsawan et al., 2007; IAEA, 2011). It is important to estimate disparity in cancer, for two reasons; first, to identify particular socio-economic groups with high burden of cancer, and second, to elucidate causes of social disparities (Krieger, 2005; Pearce and Boyle, 2005; Morra et al., 2006; Yiengprugsawan et al., 2007).

Various studies have investigated the cancer incidence in Tehran (Larijani et al., 2004; Mosavi-Jarrahi et al., 2007; Rohani et al., 2011), however the aim of this study is to estimate cancer distribution in respect to different SEP (socioeconomic position) groups and the degree of social inequalities in cancer. We also investigate whether there are disparities across 22 districts, different cancer types and sex. For this purpose, two types of disparity measures were calculated including absolute and relative disparity. Grouped cancers and probable disparities may assist identifying the cause of disease and determinants of disparities to provide early detection programs,

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populations at risk and provision of equitable curative and palliative services.

Materials and Methods

Data collection

This investigation was an ecological study. Tehran metropolitan area consists of 22 municipal districts, with a total population of 7803883 (according to 2006 census). For the initial step we obtained cancer data from Iran Cancer Registry (ICR), and SEP groups from Urban HEART project (see below). Secondly, World standardized rate (ASR) per 100000 people was calculated using the direct method of standardization to new (2000) WHO World Standards (Ahmad et al., 2009). Finally, disparity measures including absolute and relative disparity were calculated across 22 districts and SEP groups and specific disparity measures were calculated for common and special cancers in both genders.

According to the 2008-2009 ICR data published by the Ministry of Health and Medical Education, there were 7599 new cancer cases diagnosed within the boundaries of Tehran metropolitan. Cancer registry data are collected from all pathology centers and hospitals, either public or private facilities. Population of districts extracted from the national statistical center.

Home addresses were extracted from the database and mapped after controlling by the research team. Cases with no home address or telephone were discarded regarding the fact that they were probably guests from other parts of the country, temporary residents, or emigrated.

As cancer registry data does not contain individual-level measures of socioeconomic position, we linked these data at district level with Urban Health Equity Assessment and Response Tool (Urban-HEART) findings, which was conducted in the same year (2008) (Asadi-Lari et al., 2010) to assign each district a measure of socioeconomic position based on the rank of the district in Urban-HEART.

Urban-HEART project stems in SDH, and initially was developed by the WHO Centre for Health Development in Kobe, Japan (WKC) with the contribution of different regional offices of WHO worldwide and other UN agencies. In Tehran, a large population based survey using a comprehensive and validated questionnaire was conducted, where the head of households were queried about most of social determinants of family health. Almost 960 households were included in this stratified cluster multistage sample in each 22 districts and overall 21120 households were recruited in Tehran (Asadi-Lari et al. 2010).

Data analysis

Data analysis was done by Stata (v.11) and Excel. Direct standardization which is a weighted average of the age-specific rates was calculated by multiplying each crude rate by the standard population then summing the products. New world standard population (2000-2025), which reflects the average age structure of the world's population expected from the year 2000 to 2025, was used to facilitate comparative analysis globally.(Ahmad et al., 2009)

Determining socioeconomic positions (SEP) in Tehran: A variety of dimensions and components of SEP have been mentioned in the literature. Although income, education, living conditions, and occupational status are most commonly used to measure SEP, each has its own advantages and disadvantages (Galobardes et al., 2006; Shavers, 2007; Chen, 2010) For the purpose of this study, SEP groups were specified using Urban HEART data (Asadi-Lari et al., 2010) including household assets, housing characteristics and education level. Assets and house features consisted of house ownership, room per person, area per capita, having bath, kitchen, toilet, car, phone, cell phone, freezer, computer and the years of education was also calculated for individuals older than 6 years across all 22 districts of Tehran. These variables were put into principal components analysis (PCA), which is a multivariate statistical technique to reduce a set of variables in a dataset into smaller number of dimensions, which is used widely in the literature. (Fukuda et al., 2004; Moradi-Lakeh et al., 2007; Khedmati et al., 2012) A proxy value was calculated using Stata software for all individuals, then median score for each district was used for weighting districts. This was done to categorize districts of Tehran according to SEP levels and also to calculate disparity measure of cancer incidence. Districts were accordingly sorted by these values then categorised into four classes based on population of districts to make a similar population in each class. (Table 1).

Measures of disparity

There are two main approaches for disparity measurement, absolute and relative measures. The former (absolute) is influenced by population size and can be different both in direction and the quantity from relative measure of disparity. Unweighted measures (relative) seem to be more sensitive to repositioning of rates,

Table 1. Classification of Districts with Regard to their SEP Values and Population

SEP	Districts	District's proxy value	Population
Sep-01	17	-0.294	256022
Total population	19	-0.143	249786
2094058	16	-0.135	291169
	15	-0.130	644259
	18	-0.062	317188
	20	0.068	335634
Sep-02	10	0.117	315619
Total population	9	0.128	165903
1893760	12	0.205	248048
	14	0.226	483432
	11	0.252	275241
	13	0.398	245724
	21	0.509	159793
Sep-03	4	0.520	822580
Total population	7	0.531	310184
1620163	8	0.546	378725
	22	0.646	108674
Sep-04	5	0.751	679108
Total population	6	0.856	237292
2195902	2	0.870	608814
	1	0.953	379962
	3	1.058	290726

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particularly those of smaller population groups (Harper et al., 2008). Disparities may be improved or deteriorated in a population over time, therefore absolute measure may have more indication to be used, while, relative measure may be more understandable for health policy making. Nevertheless, improvements in public health usually rely on the progress in absolute burden of disease, which indicates the priority of absolute measure (Harper et al., 2008).

Measures of Relative Disparity

Index of Disparity (IDisp), index of Disparity (ID) indicates what is the average deviation of a specific group rate from the reference group's rate, divided by the reference group's rate: (Messer, 2008) ID isp = $(^{J=1}\sum_{I=1} |r_j - r_{ref}| / J) / r_{ref}$ x 100

Where r_j indicates the measure of cancer rates in the j_{th} group, r_{ref} is the cancer rates indicator in the reference population, and J is the number of groups which are being compared (Pearcy and Keppel, 2002). Index of disparity as a modified magnitude of variation between groups, was used to measure disparity across 22 districts of Tehran.

Relative Concentration Index (RCI)

RCI indicates the extent to which cancer rate is concentrated among particular social groups according to social group ranks, (Messer, 2008) which is calculated through the following formulae: RCI $=2/\mu\ ^{j}\sum_{j-1}(p_j\,\mu_j R_j)-1$

Where p_j is the group's population share, μj is the group's mean health, and R_j is the relative rank of the jth socioeconomic group: $R_j = {}^{J}\sum_{j-1} (p_y - 0.5\, p_j)$

Where p_y is the cumulative share of the population up to and including group j and p_j is the share of the population in group j. (Kakwani et al., 1997; Harper et al., 2008) When cancer rate increases with the higher rank of social groups, it will be shown as a positive RCI, whereas decreasing rate results in a negative RCI. When no disparity exists, the RCI is zero. (Black et al., 2010; Lee et al., 2010)

Measures of Absolute Disparity

Absolute Concentration Index (ACI), ACI demonstrates the cumulative proportion of cancer rate in each social group to the average rate of population cancer. (Messer 2008) ACI = μRCI, μ stands for population average. Several reasons have been given for the selection of ACI and RCI to differentiate SEP groups: they mark changes in the social groups over time and across the entire range of social groups; they are adjustable for different levels of disagreement disparity; and they are sensitive to the direction of the social gradient in health (Yiengprugsawan et al., 2007; Harper and Lynch, 2010).

Between-Group Variance (BGV)

BGV indicates how different are the cancer rates between districts or social groups and mean cancer rate in the population weighting by social group size: (Messer 2008) BGV = $^{J}\sum_{j-1} p_j\, (y_j - \mu)^2$

Where p_j is group j_s population share, y_j is group j's average health status, and μ is the population average. BGV as a summary of absolute disparity has been recommended whenever there are comparisons between multiple unordered groups because it can be decomposed ideally into between and within social group components. The ability of the variance measure to decompose disparity is important because it accounts the number of cross-classified social groups whether ordered or not, which sounds a useful tool for describing and understanding the stratification of cancer-related health outcomes across time (Harper and Lynch, 2010).

Results

A total of 8408 new cancer cases had been reported in 2008 in Tehran within the mandatory pathology registry of cancers. Of these, 809 cases were excluded from our study due to locating out of Tehran metropolitan official boundaries. Out of 7599 remaining cases, 157 were unknown or with no recorded address to identify their district of residential area. Maximum ASRs in both genders were in districts 6, 3, 1 and 2. The highest ASRs in women were in districts 3, 6, 1 and 2 and in men in districts 6, 1, 3 and 2. ASR in both sexes (7599 cases) was 117.2 per 100,000. Common cancers were breast, colorectal, stomach, skin and prostate cancers. ASR was 120.4 for men and 113.5 (per 100,000 population) for women.

Cancer ASR was correlated with districts SEP ranking, where the higher rank districts had higher ASR relative to other districts (Pearson r = 0.9, p<0.001). Positive ACI and RCI indicated cancer cases accumulated in districts with higher SEP. Women disparity was more than men in all measure (Table 2).

Women ASR in SEP groups were less than men except

Table 2. Cancer ASR Per 100,000 and Measures of Absolute and Relative Disparity in Tehran Districts

Districts	Males	Females	Total
1	163.4	158.7	162.7
2	147.3	140.4	145.1
3	153.4	177.9	166.8
4	109.5	119.8	114.9
5	146.7	132.6	140.5
6	187.6	168.8	178.6
7	147.7	111.5	128.2
8	100.0	93.5	97.0
9	82.2	83.1	82.1
10	93.5	85.3	88.5
11	114.2	125.5	118.5
12	103.9	90.0	96.7
13	120.4	96.8	108.4
14	76.7	84.6	80.3
15	80.8	79.5	80.3
16	90.9	73.6	81.9
17	68.5	62.5	65.7
18	91.7	60.4	77.6
19	90.0	47.4	70.2
20	98.4	102.4	100.6
21	106.3	90.8	98.9
22	124.7	83.7	106.4
Total	120.4	113.5	117.2
ACI	4.766	16.7	10.2
BGV	2070	2080.9	2044.5
IDisp	22.9	27.5	24.4
RCI	0.087	0.147	0.040

Table 3. ASR of Common and Female Dominant/Female Dominant Cancer Types and Measures of Disparity between Various SEP Groups of Tehran Inhabitants

Cancers		Cancer ASR in various SES groups				Absolute Disparity		Relative Disparity	
		Sep-01	Sep-02	Sep-03	Sep-04	ACI	BGV	IDisp	RCI
Female:	Breast	17.2	29.6	38.1	55.0	5.368	21448	30.471	0.141
	Colorectal	7.3	9.0	13.8	16.3	1.486	1410	28.290	0.122
	Skin	6.9	9.1	7.0	9.0	-0.155	131	12.304	-0.018
	Stomach	6.5	5.4	5.8	9.0	0.302	219	19.403	0.042
	Ovary	2.5	4.7	3.7	7.4	0.486	369	32.754	0.095
	Uterus	3.3	2.3	4.1	7.4	0.593	406	37.630	0.0125
	Cervix & vagina	2.7	2.3	1.8	2.1	-0.167	10	11.898	-0.073
Male:	Prostate	7.2	14.1	16.7	31.7	3.07	9067	41.919	0.157
	Colorectal	8.9	12.3	14.6	24.2	1.863	3683	32.353	0.113
	Stomach	14.0	11.1	13.4	15.2	-0.01	241	8.474	-0.001
	Skin	11.6	10.4	9.8	15.3	0.206	490	16.833	0.0166
	Bladder	6.3	8.2	14.2	15.3	1.48	1561	32.62	0.128
	Testis	0.5	1.2	0.8	1.1	0.074	8	26.809	0.078

Table 4. Cancer ASR and Measures of Absolute and Relative Disparity between Various SEP Groups of Tehran Inhabitants

SEP groups	Men ASR	Women ASR	Total ASR
Sep-01	77.300	73.500	80.100
Sep-02	116.900	93.600	94.800
Sep-03	138.400	107.300	111.400
Sep-04	133.600	151.200	154.600
ACI	7.0820	10.457	109.022
BGV	62107	93405	891620
IDisp	16.146	22.843	21.903
RCI	0.059	0.092	0.930

in the highest SEP group, where women ASR was more. ASR trend in women is ascending and disparities measures are higher than men (Tables 3 and 4). Breast and colorectal cancer incidence were ascending across SEP groups in women but skin and ovary cancers had an irregular pattern. When ACI and RCI tend to zero, it indicates that no particular pattern exists in SES gradients. Negative ACI and RCI in skin and cervical cancer indicated that these cancers accumulated in lower SEP groups. Breast cancer had higher between group variance, RCI and ACI, while uterus cancer had higher index of disparity.

Prostate, colorectal and bladder cancers had ascending trend in men but no particular pattern was seen in other cancers. Stomach cancer incidence had negative ACI and RCI, however no consistent pattern existed according to socioeconomic position. Prostate cancer had the highest disparity measures in men, while it had the highest rate of index of disparity among both genders (Table 3).

Discussion

This study provided GIS-based cancer distribution, incidence and its disparities across 22 districts of Tehran metropolitan area, within four SEP groups, different cancer types and genders, also assesses the degree of inequality in the distribution of cancers. We used two types of disparity measures including absolute and relative disparity measures, each of which has pros and cons. This study indicates that there are remarkable socio-economic disparities exist in cancer incidence. Districts 3 and 6, which are classified in the SEP IV (the most affluent group) had the highest cancer ASR. Although there have been some cross region studies to assess associations between SEP and health, (Burack et al., 1983) most studies investigated trend of disparities in health outcomes. (Black et al., 2010; Jones et al., 2010)

Age standardised rates (ASR), which was used instead of the crude rates to facilitate international comparison, may lead to a deformity of the raw data. (Burack et al., 1983; Anderson and Rosenberg, 1998) Therefore we assessed the impact of the ASR on the crude rate, where the findings showed that minor differences exist between ASR and crude rates across districts, while the SEP ranks of districts remained unchanged.

We measured disparities across socioeconomic positions at district level, which was based on accumulation of individual data to make districts values (stemmed in Urban-HEART data), thus, according to the ecologic design of this study, inferences may not reflect case attributes. Murray et al advocate that analysis of social group health differences, which may mask part of health disparities at individual level, should be abandoned (Murray et al., 1999; Gakidou et al., 2000). However, there are convincing reasons to measure social group health differences: measures of the distribution of health outcomes at individual level are neither possible to calculate SEP and assign a health index for everybody, nor justify the causal pathways linking socioeconomic mechanisms and interventions for elimination of disparities.

Analyses using other SEP ranks by different definitions may lead to different results. We used area based SEP index that in Spadea study has seen a smaller proportion on the overall risk of cancer among men rather than individual SEP measure (Spadea et al., 2010) as well as direction of the relationship between SEP and health outcome are more complicated in some of the studies, particularly with regard to risk factors (Vagero and Leinsalu, 2005). Braveman et al believe that health inequalities correlated with factors apart from income and social class and exist when risks of diseases in the community are unequal. (Braveman et al., 2001).

In our study all cancer incidences, but stomach, cervical and skin cancers in women, accumulated in high SEP groups, which is in line with other cancer inequality studies (Merletti et al.) A dramatic shift has been recognised in the Netherlands during 1996–2008, where the highest incidence in low SEP groups has been replaced by high SEP groups (Aarts et al., 2010) and the impact of SEP on cancer differed by cancer types.

A systematic review of socioeconomic differences in cancer incidence and mortality on 37 populations in 21 countries showed that relationship with SEP appeared in opposite directions; excess risk of respiratory and upper GI cancers in men and oesophagus, stomach and cervix cancers in women were seen in lower social strata, while colon, melanoma and lung in men and colon, breast, ovary and melanoma in women were more frequent in higher social strata (Faggiano et al., 1997). It has been shown that breast and lung cancers were more prevalent in high educated women, while cervical cancer was frequent in more disadvantage groups (Spadea et al., 2010). In addition, less educated men had lower risks of melanoma and prostate cancers, and less educated women were less likely to be diagnosed with melanoma, ovarian and breast cancers (Spadea et al., 2009). In our study cervical cancer accumulated in lower SEP and colon cancer, breast, prostate and ovarian cancer had a positive ACI, which indicates the excess risk of these cancers in higher SEP groups. Despite our ecologic design, almost all of our findings were comparable to other studies, while if we had individual cancer and SEP data, more accurate individualised inferences may be reached.

Increased usage of screening programmes could be the most persuading explanation for the higher incidence of breast and prostate cancers among high SEP groups (Bigby and Holmes, 2005; Gilligan, 2005; Hoffman et al., 2005) it could be contrary for cervical cancer because of lower screening rates and Sexual behaviour risk factors among women of lower SEP, (Santelli et al., 2000) however lack of individual data prohibit us to make such inferences. It is reported that stomach cancer incidence varied across different geographic regions, which may be associated with genetic, lifestyle or environmental factors (Armstrong and Doll, 1975; Forman and Burley, 2006). Negative ACI in stomach cancer indicates cancer accumulation in lower SEP, which maybe attributable to poor health conditions such as *H pylori*.

This ecologic study suffers from a number of limitations; confounding factors such as diet, lifestyle, habits, genetic and environmental factors were not controlled, adjustment for smoking and diet may have different results for lung cancer (Menvielle et al., 2009). Another limitation of this study was that we measured current socioeconomic characteristics with cancer incidence, while there is a considerable time lag between the SEP factors and cancer incidence; i.e. one may transpose to different social classes during lifetime. Some cancers such as breast, cervical, and colorectal are embedded in their most recent social circumstances (Naess et al., 2005; De Kok et al., 2008), in contrary to stomach cancer which is correlated with social circumstances during infancy and adolescence (Power et al., 2005; Lawlor et al., 2006). Our findings regarding stomach cancer did not confirm the previous studies, which may be either due to the fact that we have measured their current SEP, while stomach cancer may be more correlated with early life SEP; or as a reason of high fatality rate of gastric cancer which in turn leads to rather incomplete data. Districts were classified based on their asset and education positions, which may inherently limit the concentration indices which are insensitive to changes in socioeconomic position within a group, hence will not affect socioeconomic ranking. This might be improved if we used individual or household level instead of district level SEP data.

In conclusion, this study demonstrates the amount of disparities in major cancer incidence in 22 districts of Tehran across SEP groups. Disparities existed more in women, while the choice of a summary measure of disparity may affect the interpretation of disparities. Higher ASR in particular districts warrants further research to investigate the predisposing factors. Further research with improved cancer registry is required to identify individual SEP factors associated with cancer incidence. This may help researchers and health policy makers to investigate for preventive policies, to meet patients' needs, and to provide better services.

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