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ORIGINAL ARTICLE

Gender-specific changes in physical activity pattern in Iran: national surveillance of risk factors of non-communicable diseases (2007–2011)

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Abstract
Objectives This study describes the gender-specific pattern of physical activity (PA) in Iran 2011. The 4-year changes in PA levels (domains) are also determined according to the Iran's national surveys conducted on 2007 and 2011.
Methods Physical activity assessed based on the global physical activity questionnaire. In all, 4,121 (2007), and 7,436 (2011) adults were analyzed.
Results Based on 2011 survey, 56.4 %, 39.2 %, and 74.4 % of participants were physically inactive at work, commuting and recreation, respectively. In all domains of PA, males showed a higher degree of activity (min/day) than females (P value <0.001). The overall prevalence of physical inactivity was increased from 15 % (2007) to 21.5 % (2011) (P value <0.001). Over the 4 years, a significant decline in total physical activity (MET × min/week) and the duration of commuting activity were noted in both genders. Work-related activity was dramatically decreased in females. However, the time spent in recreational activity remained relatively constant.
Conclusions This report indicating that the Iranian population, particularly females, have become less active during the survey period. Physical inactivity should receive more attention as a public health issue.

Keywords Physical activity · Adult · Iran · Epidemiology · GPAQ · Health surveys

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Introduction

Increasing prevalence of physical inactivity has become a global concern (Kohl et al. 2012). Physical inactivity is estimated to account for 6–10 % of the major non-communicable diseases (NCDs) including coronary heart disease, type 2 diabetes, as well as certain types of cancer (Allender et al. 2008, 2011; Lee et al. 2012; Patel and Burke 2009). It also contributes to 9 % of premature mortality (Lee et al. 2012).

Despite positive influence of rapid urbanization on economy of the developing countries, it has caused enormous disadvantages on the pattern and the prevalence of NCDs, as well as on the corresponding modifiable risk factors such as physical inactivity, obesity, tobacco use, detrimental nutritional habits and inadequate fruit and vegetable consumptions (Allender et al. 2008, 2011; Lee et al. 2012; Patel and Burke 2009; Warren et al. 2010).

Physical activity is defined as a complex set of behaviors including various kinds of bodily movements produced by skeletal muscles that result in energy expenditure (Brownson et al. 2005; Caspersen et al. 1985; Warren et al. 2010). In view of the compelling evidence of the contribution of physical activity in mortality reduction of NCDs, population trends in physical activity have recently received more attention by policy makers with respect to implementation of national preventive programs (Allender et al. 2008, 2011; Lee et al. 2012; Ng and Popkin 2012). Nonetheless, due to the scarcity of continuous national surveillance systems, disparities in methodological aspects and different questionnaire used for the measurement of physical activity (Armstrong and Bull 2006; Ng and Popkin 2012), there are still notable gaps in assessing global pattern and trends of physical activity, particularly in low and middle income countries.

Almost similar trajectories are happening in Iran, a Middle Eastern country, with rapid urbanization, population growth, and increasing rates of migration in the recent decades (Esteghamati et al. 2009; WHO 2012).

Similar to many other developing countries, Iran is also in the process of lifestyle transition. This results in an increased prevalence of obesity and diabetes through changes in the dietary patterns and physical activity (Esteghamati et al. 2010, 2011a, b; Ghassemi et al. 2002). On the other hand, rapid growth of diabetes and cardiovascular diseases has urged the need of assessing country-level trends of NCDs risk factors for design of lifestyle modification programs (Azizi et al. 2009; Esteghamati et al. 2009). Although previous reports studied a number of these risk factors (Esteghamati et al. 2009, 2010), less is known about changes in physical activity measures of Iranian populations.

Surveillance of risk factors of non-communicable diseases (SuRFNCD) is a nationwide survey of Iranian adults conducted periodically by the Iran's Center for Disease Control (CDC), Ministry of Health and Medical Education, Iran. In the 2007 and 2011 cycles of the survey, prevalence of physical activity using the global physical activity questionnaire (GPAQ), in accord with World Health Organization (WHO) guidelines, has been determined.

Our previous study showed that physical inactivity is common in Iran (Esteghamati et al. 2011a). Further, presence of gender disparities in physical activity is a likely hypothesis in socio-cultural settings like Iran. Nevertheless, no previous report on gender-specific pattern and changes in physical activity has elucidated the situation in the region.

The present study updates our previous report (Esteghamati et al. 2011a) and describes overall and gender-specific pattern of sedentary behavior and physical activity in different domains including work, commute and recreation across different age groups and residential areas in Iran, 2011. It also presents the prevalence of physical inactivity among Iranian adults aged 25–64 years. Additionally, changes in physical activity levels (domains) over the period of 4 years are determined.

Methods

Study population and survey sampling

SuRFNCD-2011

The survey was conducted between May 22nd and June 20th 2011 based on a randomized multi-stage cluster sampling method. Institutionalized individuals such as soldiers, those hospitalized or living in nursing homes during the course of study, and nomadic tribes were not included. By employing a four-stage sampling scheme, a total of 11,867 Iranian individuals aged 6–70 years were surveyed. Of the total of 402 counties across the country, 50 were randomly selected as primary sampling units (PSUs). Within each PSU, 12 areas were selected as secondary sampling units (SSUs) comprising urban–rural area segments. Sampling was proportional to the population size of PSUs and SSUs. In the third stage, 20 valid 10-digit postal codes were randomly chosen from each SSU. Presuming that WHO conventional Kish tables would result in undersampling of adults ≥55 years, two independent sets of Kish tables for persons <55 and ≥55 years were developed. In the final stage, the participants were chosen employing Kish tables. The first three stages of sampling were directly conducted by CDC. The fourth stage was carried out through a face to face interview and was supervised by 43 medical schools across the country.

Interviewers were trained on the survey details, conduct of interview, and recording the assessments during a 1 day workshop held in Tehran, prior to the study commencement. Informed consent was formally obtained from all participants, at the beginning of each interview. In case of absence of the participants, the interviewers were instructed to return for a second and third visit. In the event that none of the three attempts were successful (due to non-presence or refusal to consent), the label 'non-response' was applied. All procedures were conducted in accordance with the guidelines and standards laid down in the current revision of Helsinki declaration. After excluding non-responders and participants with missing data on each domain of physical activity questions ($n = 117$), a total of 7,436 males and non-pregnant females aged between 25 and 64 years with valid response to the questions were recruited for the final analysis.

SuRFNCD-2007

The data from SURFNCD-2007 (March) (Esteghamati et al. 2009) were employed to analyze the changes in physical activity patterns between 2007 and 2011. A total of 4,121 Iranian adults aged 25–64 years with valid responses to questions were included. Despite differences in design, sampling protocol, and sample size, both surveys are representative of the Iranian population.

Physical activity questionnaire and definitions

Several questionnaires have been developed to measure physical activity, among which the International Physical Activity Questionnaire (IPAQ) and the global GPAQ, which are endorsed by the WHO, have demonstrate good reliability and validity in surveillance of within- and between-population comparisons. However, GPAQ has been used more frequently in surveillance studies in developing countries (Armstrong and Bull 2006; Bull et al. 2009; Ng and Popkin 2012; Warren et al. 2010).

In the present study, the Persian translation of the GPAQ was used to assess physical activity. GPAQ version 2.0 (Armstrong and Bull 2006; Bull et al. 2009) consists of 16 questions about different aspects of physical activity in a typical week. The GPAQ inquires about the frequency (days) and time (min/h) spent doing moderate- and vigorous-intensity activities at work (including unpaid household works) and recreation, as well as moderate-intensity commuting activity (time spend walking or cycling to and from places).

GPAQ involved only activities performed for at least 10 consecutive minutes. The moderate- and vigorous-intensity of each activity were assessed based on the amount of effort required to accelerate both respiratory and heart rate.

Show-cards were used to demonstrate typical physical activities to each participant. The time spent on sedentary behaviors (e.g., sitting, watching TV) were also determined.

The data derived from the GPAQ were cleaned, categorized and analyzed according the WHO STEP wise approach to chronic disease risk factor surveillance analyses guide (WHO 2005).

"Energy expenditure" was defined using the metabolic equivalent (MET) concept, which is the ratio of specific physical activity metabolic rates relative to the resting metabolic rate. Each unit of MET is equivalent to the energy cost of sitting quietly (1 kcal/kg/h) (Ainsworth et al. 2000; WHO 2005). In computing GPAQ data on energy expenditure, moderate-intensity activities during work, commuting, and recreation are assigned a value of "4 METs"; and vigorous-intensity activities are assigned a value of "8 METs" (WHO 2005). Energy expenditure was estimated based on the intensity (METs), duration (min), and frequency of each activity. Total physical activity (TPA) was calculated as the sum of all MET × min/week; performed at work, commuting or recreation (WHO 2005).

Per GPAQ framework, the following three levels of physical activity were defined as (WHO 2005):

1. "High"—individuals with either of the following criteria:
   - At least 3 days of vigorous-intensity activity; achieving a minimum of at least 1,500 MET × -min/week. Seven or more days of any combination of walking, moderate or vigorous-intensity activities; achieving a minimum of at least 3,000 MET × min/week.
2. "Moderate"—individuals who do not meet the High level, with either of the following criteria:
   - Three or more days of vigorous-intensity activity for at least 20 min/day.
   - Five or more days of moderate-intensity activity or walking for at least 30 min/day
   - Five or more days of any combination of walking, moderate- or vigorous-intensity activities resulting in a minimum of 600 MET × min/week.
3. "Low"—participants not meeting any of the above-mentioned criteria fall into this category.

Furthermore, patients who do not have any work, commuting and recreation activity were considered as physically inactive (Bull et al. 2009).

Table 1 Prevalence of high, moderate and low level physical activity in Iranian adults aged 25–64 years, 2011

Levels of physical activity	Male's				Female's				Total			
	Pop est.	Low % (95 % CI)	Moderate % (95 % CI)	High % (95 % CI)	Pop est.	Low % (95 % CI)	Moderate % (95 % CI)	High % (95 % CI)	Pop est.	Low % (95 % CI)	Moderate % (95 % CI)	High % (95 % CI)
Age groups												
25–34	7.87	23.9 (20.7–27.1)	16.3 (13–19.6)	59.8 (55.2–64.3)	7.77	50.8 (46.3–55.3)	19.8 (17.1–22.5)	29.4 (24.5–34.3)	15.63	37.3 (34.2–40.3)	18 (15.8–20.2)	44.7 (41.1–48.2)
35–44	5.33	32.8 (28.1–37.5)	15 (11.1–18.8)	52.2 (47.3–57)	5.14	45.6 (39.4–51.7)	24.2 (20.5–27.8)	30.2 (24.6–35.7)	10.47	39.2 (34.9–43.3)	19.5 (16.6–22.4)	41.3 (37.7–45)
45–54	3.79	30.2 (25.9–34.2)	13.2 (9.4–16.9)	56.6 (50.8–62.5)	3.76	50.4 (45.6–55.1)	18.6 (15–22.2)	31 (26.2–35.8)	7.55	40.2 (37.1–43.1)	15.9 (13.1–18.6)	43.9 (39.7–48.1)
55–64	2.21	33.2 (29.5–36.8)	15.4 (13.1–17.7)	51.4 (47.6–55.2)	2.33	54.1 (48.5–59.5)	16.9 (14.1–19.8)	29 (23.8–34.2)	4.54	43.9 (39.8–47.9)	16.2 (14.4–18)	39.9 (35.9 –43.9)
Residential area												
Urban	14.28	29.9 (27.1 –32.5)	16.6 (14–19.3)	53.5 (49.6–57.3)	14.05	49.8 (45–54.5)	21.8 (19.4–24.2)	28.4 (23.7–33.1)	28.33	39.7 (32.3–42.5)	19.2 (17.2–21.2)	41.1 (37.8–44.2)
Rural	4.91	25.2 (20.1–30.2)	11.1 (8.2–13.8)	63.7 (57.5–69.9)	4.95	49.6 (42.6–56.5)	16.3 (13.1–19.5)	34.1 (27.2– 41)	9.86	37.5 (36.7–42.7)	13.7 (11.4–16)	48.8 (43.2–54.5)
Total	19.19	28.7 (26.1–31.2)	15.2 (13.1–17.3)	56.1 (52.4–59.7)	19.01	49.7 (45.4–53.9)	20.4 (18.2–22.6)	29.9 (25.5–34.2)	38.2	39.1 (36.4–41.9)	17.8 (16–19.5)	43.1 (39.9–46.2)

Pop est. population estimates according to Iran's population in 2011 and are rounded to the nearest million

Statistical analysis

The complex survey data analysis was performed using Stata software version 11 for Windows (Stata Corporation, Texas). After accounting for design and non-response weights, survey participants were extrapolated to the 2011 population of Iran. Design weight was defined as the inverse of the probability of selecting each sampling person, and was calculated for each step of the sampling and for Kish tables by CDC. Data were also extrapolated using non-response weights, which were generated for age (10-year strata 25–34, 35–44, 45–54, and 55–64), sex (male, female) and area of residence (urban, rural).

The prevalence of physical activity states are reported as proportions along with the 95 % confidence intervals. Continuous variables such as time spent in different domains of physical activity are expressed as mean ± standard error of mean (SEM) and Median (1st–99th centile). Design-based Chi-square test was used to investigate the differences in prevalence rates across binary categories. Design-based logistic regression models were conducted using different levels (domains) of physical activity as the dependent variable to assess the changes occurred in the status of physical activity over the 4 years period.

Odds ratios (ORs) along with 95 % CI for each outcome were calculated for every 1 year increase in calendar year (0 for 2007 and 4 for 2011), after adjusting for age (as a continuous variable) and area of residence (as a binary variable). The *P* value <0.05 was considered statistically significant.

Results

Levels of physical activity

The national estimates of 2011 Iran's population and the prevalence of high, moderate and low levels of physical activity are shown in Table 1.

After extrapolations to the Iran's 2011 population, 39.1 % (14.93 million), 17.8 % (6.79 million) and 43.1 % (16.46 million) of individuals were classified into low, moderate and high activity categories, respectively. Males and residents of rural area had higher levels of physical activity compared to females and residents of urban area (*P* value <0.001).

Time spent on physical activity

About 70.5 %, 18 % and 11.5 % of daily physical activity belonged to work, commuting and recreation domains, respectively. TPA (MET × min/week), and the average daily time spend in work-, commuting- and recreational-related activities and sedentary behavior are shown in

Table 2 Total physical activity, the average times spend at work, commute, recreation, and sedentary behavior, status by gender in Iranian adults aged 25–64 years, 2011

	SuRFNCD 2011			
	Male's Mean + SEM Median (1st–99th centile)	Female's Mean + SEM Median (1st–99th centile)	Total Mean + SEM Median (1st–99th centile)	*P* value[d]
Total physical activity (MET × min/week)				
Age groups[a]				
25–34	6,370.24 ± 458.3	1,651.78 ± 133.62	4,025.55 ± 231.53	Age
	2,480 (0–35,280)	560 (0–13,440)	1,080 (0–31,680)	M: 0.33
35–44	6,273.85 ± 663.05	1,836.31 ± 178.44	4,096.57 ± 349.4	F: 0.98
	1,680 (0–42,000)	720 (0–15,360)	960 (0–33,600)	T: 0.26
45–54	6,228.36 ± 809.52	1,681.81 ± 145.81	3,963.28 ± 442.42	
	2,256 (0–42,000)	560 (0–16,800)	800 (0–33,600)	
55–64	6,088.38 ± 1,240.21	1,802.02 ± 154.11	3,884.85 ± 611.11	
	1,680 (0–37,800)	480 (0–20,640)	840 (0–34,440)	
Residential area[b]				
Urban	5,714.57 ± 506.5	1,595.85 ± 124.53	3,672.21 ± 266.88	Urban/rural
	1,680 (0–40,320)	540 (0–15,120)	840 (0–31,680)	M: 0.008
Rural	7,936.10 ± 714.41	2,095.32 ± 244.72	5,003.14 ± 386.06	F: 0.07
	2,880 (0–39,000)	660 (0–21,840)	1,120 (0–33,600)	T: 0.003
Total[c]	6,283.05 ± 436.88	1,726.07 ± 123.47	4,015.98 ± 236.03	Male/female
	1,800 (0–39,840)	560 (0–18,360)	840 (0–33,240)	T: < 0.001
Work-related physical activity (min/day)				
Age groups[a]				
25–34	113.43 ± 10.51	27.16 ± 2.98	70.56 ± 5.61	Age
	8.57 (0–720)	0 (0–320)	0 (0–600)	M: 0.16
35–44	122.96 ± 13.53	37.74 ± 5.51	81.15 ± 7.56	F: 0.65
	14.28 (0–720)	0 (0–480)	0 (0–720)	T: 0.2
45–54	113.46 ± 16.94	28.57 ± 4.15	71.17 ± 9.6	
	12.86 (0–780)	0 (0–368.57)	0 (0–600)	
55–64	86.3 ± 8.67	31.27 ± 4.04	58.01 ± 5.50	
	0 (0–737.14)	0 (0–480)	0 (0–660)	
Residential area[b]				
Urban	98.85 ± 10.37	26.83 ± 3.37	63.14 ± 6.038	Urban/rural
	0 (0–737.14)	0 (0–390)	0 (0–617.14)	M: 0.001
Rural	154.02 ± 15.62	42.06 ± 6.42	97.8 ± 8.38	F: 0.01
	0 (0–720)	0 (0–480)	0 (0–642.86)	T: < 0.001
Total[c]	112.96 ± 9.45	30.81 ± 3.45	72.09 ± 5.52	Male/female
	0 (0–728.57)	0 (0–420)	0 (0–634.28)	T: < 0.001
Commuting-related physical activity (min/day)				
Age groups[a]				
25–34	36.29 ± 5.89	18.83 ± 1.30	27.61 ± 2.92	Age
	8.57 (0–300)	8.57 (0–128.57)	8.57 (0–210)	M: 0.93
35–44	27.94 ± 2.80	19.32 ± 1.37	23.71 ± 1.71	F: 0.18
	8.57 (0–240)	8.57 (0–180)	8.57 (0–180)	T: 0.87
45–54	37.24 ± 3.42	20.15 ± 1.11	28.73 ± 1.88	
	15 (0–342.85)	8.57 (0–120)	8.57 (0–240)	
55–64	37.47 ± 1.91	22.61 ± 1.99	29.83 ± 1.69	
	17.14 (0–300)	8.57 (0–210)	10 (0–240)	

Table 2 continued

	SuRFNCD 2011			
	Male's Mean + SEMMedian (1st–99th centile)	Female's Mean + SEMMedian (1st–99th centile)	Total Mean + SEMMedian (1st–99th centile)	*P* value[d]
Residential area[b]				
Urban	33.43 ± 3.36	19.14 ± 1.09	26.35 ± 1.86	Urban/rural
	12.85 (0–300)	8.57 (0–120)	8.57 (0–214.28)	M: 0.74
Rural	36.78 ± 3.01	21.24 ± 1.96	28.98 ± 2.25	F: 0.31
	17.14 (0–300)	8.57 (0–220)	10 (0–240)	T: 0.33
Total[c]	34.29 ± 2.58	19.69 ± 1.01	27.03 ± 1.51	Male/female
	12.85 (0–300)	8.57 (0–180)	8.57 (0–240)	T: < 0.001
Recreational-related physical activity (min/day)				
Age groups[a]				
25–34	19.88 ± 2.14	8.98 ± 1.36	14.46 ± 1.36	Age
	0 (0–171.42)	0 (0–120)	0 (0–171.42)	M: 0.96
35–44	12.53 ± 2.84	4.83 ± 0.69	8.75 ± 1.6	F: 0.01
	0 (0–128.57)	0 (0–68.57)	0 (0–120)	T: 0.69
45–54	13.51 ± 2.1	6.48 ± 0.69	10.01 ± 1.11	
	0 (0–171.43)	0 (0–111.42)	0 (0–120)	
55–64	31.67 ± 21.49	5.34 ± 0.98	18.14 ± 10.46	
	0 (0–154.28)	0 (0–120)	0 (0–150)	
Residential area[b]				
Urban	19.54 ± 3.66	7.66 ± 0.91	13.65 ± 2.03	Urban/rural
	0 (0–171.42)	0 (0–120)	0 (0–154.28)	M: 0.15
Rural	13.27 ± 2.98	4.81 ± 0.91	9.02 ± 1.78	F: 0.01
	0 (0–141.42)	0 (0–115.71)	0 (0–120)	T: 0.07
Total[c]	17.93 ± 2.88	6.920 ± 0.77	12.45 ± 1.63	Male/female
	0 (0–171.42)	0 (0–120)	0(0–145.71)	T: < 0.001
Sedentary behavior (min/day)				
Age groups[a]				
25–34	242.56 ± 9.43	259.98 ± 13.10	251.22 ± 9.6	Age
	180 (15–720)	240 (10–720)	240 (10–720)	M: 0.01
35–44	262.75 ± 11.84	254.98 ± 13.63	258.94 ± 11.41	F: < 0.001
	240 (0–780)	240 (3–720)	240 (0–720)	T: < 0.001
45–54	250.2 ± 14.77	277.88 ± 16.31	263.99 ± 13.43	
	180 (20–840)	240 (15–930)	240 (15–920)	
55–64	286.79 ± 11.15	305.36 ± 15.05	296.34 ± 12.39	
	240 (15–840)	240 (30–840)	240 (20–840)	
Residential area[b]				
Urban	256.99 ± 10.49	268.88 ± 14.17	262.88 ± 11.25	Urban/rural
	240 (15–810)	240 (15–810)	240 (15–810)	M: 0.62
Rural	248.30 ± 15.57	264.54 ± 15.45	256.46 ± 14.50	F: 0.75
	210 (10–750)	240 (15–930)	240 (15–840)	T: 0.66
Total[c]	254.76 ± 9.58	267.75 ± 13.01	261.22 ± 10.37	Male/female
	240 (15–810)	240 (15–840)	240 (15–840)	T: 0.18

M male, *F* female, *T* total

[a] Adjusted for residential area

[b] Adjusted for age

[c] Adjusted for age and residential area

[d] *P* value for the association between age, residential area, sex and physical activity domains

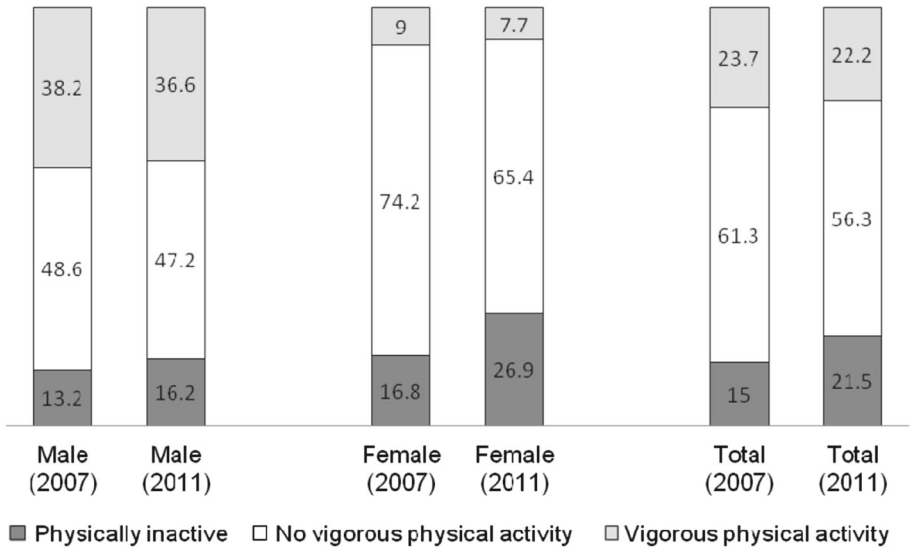

Fig. 1 Distribution of participants classified for different intensity of physical activity, Iran 2007–2011

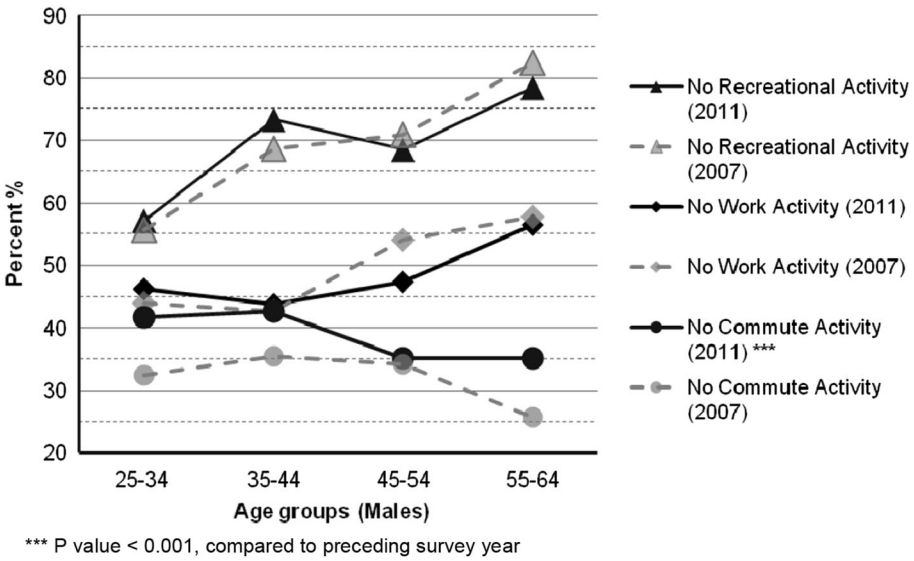

Fig. 2 Distribution of participants classified as doing no work-, commuting-, recreational-related activity in males, Iran 2007–2011

Table 2. In all domains of physical activity males showed a significantly higher degree of activity compared to females (P value <0.001); however, no significant difference in sedentary behavior was observed between males and females (P value 0.18).

Intensity of physical activity

Figure 1 demonstrates the percentage of individuals engaged in various intensities of physical activity from both surveys. Based on the 2011 survey, the overall prevalence of physical inactivity was 21.5 % (16.8 % in males, 26.9 % in females). In both surveys, females were significantly more physically inactive, and did less vigorous-intensity activity compared to males (P value <0.001).

Patterns of no physical activity during work, commuting and recreation

Based on the 2011 survey, 56.34 %, 39.23 %, and 74.48 % of participants were classified as being physically inactive at work, commuting and recreation, respectively.

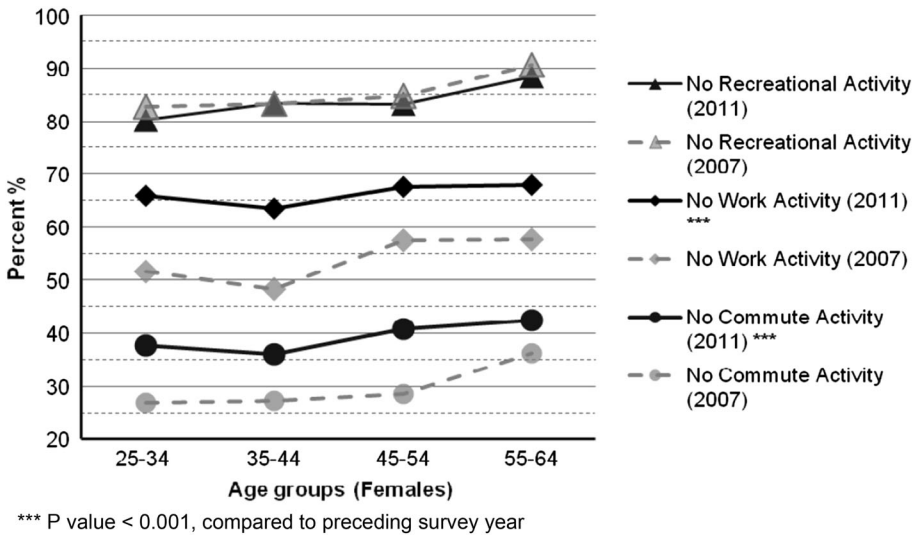

Fig. 3 Distribution of participants classified as doing no work-, commuting-, recreational-related activity in females, Iran 2007–2011

Table 3 Changes in different levels (domains) of physical activity, adjusted for age and residential area, in Iran (2007–2011)

	Male's		Female's	
	Odds ratio (95 % CI)	*P* value	Odds ratio (95 % CI)	*P* value
Levels of PA				
Low	0.96 (0.93–0.99)	0.03	1.01 (0.98 –1.04)	0.25
Moderate	0.88 (0.84–0.92)	<0.001	0.91 (0.87–0.94)	<0.001
High	1.12 (1.09–1.16)	<0.001	1.07 (1.03–1.10)	<0.001
Intensity of PA				
Inactive	1.05 (1.01–1.11)	0.01	1.16 (1.12 –1.21)	<0.001
No vigorous PA	0.98 (0.95–1.01)	0.30	0.90 (0.87 –0.93)	<0.001
Vigorous PA	0.99 (0.95 –1.02)	0.48	0.96 (0.91 –1.01)	0.10
Total physical activity (MET × min/weeks)	0.94 (0.90–0.98)	0.01	0.86 (0.83–0.89)	<0.001
Work-related PA (min/day)	1.00 (0.97–1.04)	0.57	0.87 (0.84–0.90)	<0.001
Commuting-related PA (min/day)	0.92 (0.89–0.95)	<0.001	0.89 (0.86–0.92)	<0.001
Recreational-related PA (min/day)	0.99 (0.96–1.03)	0.70	1.03 (0.99–1.07)	0.14
Sedentary behavior (min/day)	1.03 (0.86–1.23)	0.72	1.09 (0.92–1.28)	0.28

PA physical activity

Recreation was the most passive domain, while commuting represented the most active domain, especially in females [Figs. 2 (males), 3 (females)].

The percentage of males classified as doing no physical activity at work and recreation was significantly increased across age groups (*P* value <0.001 for both). Females tended to be more physically inactive in recreation in the older age groups (*P* value <0.001), though no evident changes in work and commuting inactivity occurred by age. Furthermore, a higher proportion of females compared to males was physically inactive at work and recreation (*P* value <0.001).

Changes in the physical activity pattern

The overall prevalence of physical inactivity was increased from 15 % in 2007 to 21.5 % in 2011 (OR = 1.12, *P* value <0.001). This increase was seen both in males and females (Table 3).

It appears that during this period, differences in physical activity levels were manifested in the proportions doing moderate and high level activities. The proportion doing low-level activities appears to be relatively stable in females and slightly decreased in males. However, an increase in the proportion of adults performing high level activities, paralleled with the decrease in the proportion doing moderate activities, was observed among both sexes (Table 3).

Over the 4-year study, a decline in TPA and commuting activity was noted in both sexes. Work-related activity was dramatically decreased in women. However, the time spent in sedentary behaviors and recreational activity remained relatively constant (Table 3). Likewise, the percentage of

individuals who had no physical activity at work (females) and commuting (both sexes) increased significantly in 2011 (Figs. 2, 3).

Discussion

The present study was launched to assess the gender-specific trend of physical activity during a 4-year period, based on Iran's national surveys conducted on 2007, and 2011. The consistent use of the same questionnaires (GPAQ) presumed as strength of this study.

Overall, this study indicated that the Iranian population, particularly females, have become less active during the survey period. Conjointly, the average amount of TPA (MET × min/week) declined significantly in both genders which was similar to the trends observed in some other countries (Brownson et al. 2005; Ng and Popkin 2012). A recent study (Hallal et al. 2012), recruited the data of adults older than 15 years from 122 countries, estimated that about 31 % of people have insufficient physical activity worldwide. This ranges from 17 % in Southeast Asia to about 43 % in the Americas and the eastern Mediterranean. However, according to another study (Dumith et al. 2011) aggregating the data from 76 countries, the overall prevalence of physical inactivity was reported to be 21.4 % (23.7 % in females, 18.9 % in males). The criteria used to define physical inactivity in these studies are the same as the definition of the low level of activity in our study. In the present study, 28.7 % of males and 49.7 % of females were classified as having low level activity, a trend fairly similar to those of Turkey (Guthold et al. 2008). However, the reported prevalence of physical inactivity in the United Arab Emirates, South Africa, Japan, Taiwan and France is higher (Bauman et al. 2009; Dumith et al. 2011; Guthold et al. 2008) than the estimates in Iran. Results of the present study suggest that during the 2007–2011 periods, the percentage of the adult population who do not have any work-, commute- and recreation-related activities has increased. On the contrary, the active individuals did higher levels of activity (MET × min/week).

Regardless of the decline in the levels of work (females) and the commute activity (both genders), no significant change occurred in the recreation-related activities during this 4-year period. This is in contrast with some other published data, mostly in developed countries including the USA (1994–2004) (Brownson et al. 2005; Roman-Vinas et al. 2007), Canada (1981–2000) (Roman-Vinas et al. 2007), Minnesota Heart Survey (1980–2000) (Steffen et al. 2006), Spain (1992–2003) (Roman-Vinas et al. 2007) and Finland (1972–1997) (Barengo et al. 2002), where a decrease in work and commuting activity as well as an increase in leisure-time activity occurred over the years of surveys. This trend can reasonably be explained by accessible transport facilities and the fact that contemporary occupations do not involve substantial physical activity. Technology suggested to be linked with reduced physical activity in domestic, community, and work environments (Ng and Popkin 2012).

Contrary to the above mentioned, a declining trend in leisure-time activity was reported in Sweden (1986–1994) (Lindstrom et al. 2003) and Australia (1997–1999) (Bauman et al. 2003).

Similar to a previous survey and other studies (Esteghamati et al. 2011a; Trinh et al. 2008), work-related activity comprised the greatest proportion of daily physical activity, whereas only about 11.5 % of total daily activity was of recreational type. Furthermore, nearly 75 % of the individuals were classified as doing no recreational activity. This could be explained by limited access or time for doing such activity often due to the socio-economical circumstances. The lower accuracy of the questionnaire-based survey could also explain this result.

In addition, the proportion of individuals with active transportation declined significantly across all age groups in both genders (Figs. 2, 3). The beneficial effect of active commuting on all-cause mortality and chronic diseases has been implied in several studies (de Nazelle et al. 2011; Hallal et al. 2012). Previous reports have stated that fewer than 5 % of individuals in Australia, Switzerland and the USA engage in active transportation (Hallal et al. 2012). This proportion is higher in Poland (33 %), France (34.9 %), Netherlands (37.9 %), China (46.1 %), Saudi Arabia (54.1 %) and Vietnam (54.2 %) (Amin et al. 2012; de Nazelle et al. 2011; Drygas et al. 2009; Hallal et al. 2012; Trinh et al. 2008). Our results declare that, regardless of the decrease in commuting activity, Iranians are still notably more active in commuting compared to populations described in the majority of other reports. However, data from low income countries are scarce (Hallal et al. 2012).

Moreover, in the 2007–2011 period, rural residents showed a significant reduction in time spent on work-, and commuting-related activities, as well as a decline in TPA which is consistent with previous studies (Dumith et al. 2011; Esteghamati et al. 2011a). This could be well attributed to a transition from agricultural labor works towards employment in the manufacturing and service industries as a result of urbanization during this period. Migration to cities has also been shown to enhance the sedentary behavior (Kohl et al. 2012).

The prevalence of high-level physical activity was reported to be 43.1 % in this study. The worldwide prevalence of such activity was 31.4 % (Hallal et al. 2012) with significant differences among various regions; as in Africa (38 %), America (24.6 %), Eastern Mediterranean

(43.2 %), Europe (25.4 %), Southern Asia (43.2 %), and Western Pacific (35.3 %) (Hallal et al. 2012).

Similar to many other studies (Amin et al. 2012; Bauman et al. 2009; Hallal et al. 2012; Sigmundova et al. 2011), in the present study, a higher percentage of males was engaged in high-level activity than females. These differences were expected to be due to the different amounts of time spent on moderate and vigorous activities. Females are more often involved in household and family tasks, which is included in the moderate-intensity activities. Social, cultural, and economic issues could also attribute to the above gender-related difference (Bauman et al. 2010; Yeats 2012). Cultural expectations and difference perspective of the women's role in society restrict the participation of women in certain forms of physical activity (Yeats 2012). Therewith, females tended to be less active than males in all domains of physical activity. Some studies suggested that the difference in physical activity between genders is associated with human development index (HDI) (Bauman et al. 2010; Dumith et al. 2011); the difference being higher in countries with lower HDI (Dumith et al. 2011).

Promoting population levels of physical activity should receive more attention as a public health issue in Iran. Several policies including informational, behavioral, social, and environmental approaches lead to acceptable increase in physical activity around the world (Heath et al. 2012). Physical education, social support in community setting, creating safe and easy access places for physical activity suggested to improve physical activity behavior (Heath et al. 2012; Kahn et al. 2002).

As the physical activity estimates are based on self-reported activities, there is some reliability issues associated with recall of activities, particularly in the rural groups or those with low level of education (Armstrong and Bull 2006; Bauman et al. 2009; Esteghamati et al. 2011a, b; Warren et al. 2010). Moreover, pooled results on criterion validity have shown fair agreement (Kappa 0.2–0.4) between GPAQ and objective estimates of physical activity. There were marked differences among subgroups. Men, those with higher education and rural residents had stronger correlation (Bull et al. 2009).

Overall GPAQ provides reproducible data and showed a moderate–strong positive correlation with IPAQ (Bull et al. 2009). However, the use of the IPAQ questionnaire in most of the afore-mentioned studies tends to overestimate the duration of physical activity (Bauman et al. 2009; Dumith et al. 2011; Ng and Popkin 2012).

In this study, measurement error is not considered remarkable by application of same questionnaire (GPAQ) in both surveys. By using show cards and suitable cultural examples, it was ensured that participants had fairly similar perceptions about the meaning of physical activity. Our study was not affected by seasonal changes in the physical activity behavior, as both surveys were conducted in the same time of the year.

Conclusions

Taken together, these data suggest that physical inactivity was substantially increased during the survey period. The prevalence of physical inactivity was higher among females and in those residing in the urban areas. The growing burden of NCDs indicates that physical inactivity should receive more attention as a public health issue (Hallal et al. 2012), especially in countries with a rapid lifestyle transition. Prompt action needs to be taken to set up interventions to promote physical activity in Iran, particularly for female populations and in terms of recreational activities.

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