Original Article

Social Determinants of Health and Diabetes: Results from a Cohort Study in Iran

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Abstract

Introduction: The relationship between social factors and diabetes has mainly been studied in developed countries. Few studies investigated the relationship between social factors and diabetes in developing countries. This study aimed to identify the social factors affecting diabetes in the population covered by the Hoveyzeh Cohort Study (HCS) in Iran. **Methods:** This was a cross-sectional analysis conducted on the participants of the HCS (recruited from May 2016 to August 2018), in Iran. The desired information included age, sex, marital status, education, body mass index (BMI), physical activity, Townsend deprivation index, and wealth index and their relation to diabetes. A logistic regression model was used to explore the data. **Results:** In all, the data from 10,009 adults aged from 35 to 70 years were analyzed. Of these, 2226 were diabetic and 7783 were nondiabetic. The results of multiple logistics indicated significant associations between age, physical activity, BMI, and diabetes status. In addition, the analysis showed that people who reside in most affluent areas (odds ratio [OR] = 1.39, 95% confidence interval [CI]: 1.21–1.60) and individuals who reside in affluent areas (OR = 1.25, 95% CI: 1.08–1.46] were more likely to experience a higher risk of diabetes compared to those who live in most deprived areas. **Conclusion:** The findings showed that people with older age, lower physical activity, higher BMI, and affluent background were more likely to develop diabetes. Future studies are needed to confirm such an observation. Perhaps social class might play different roles in low-, middle-, and high-income countries. Health promotion interventions to reduce diabetes should incorporate socioeconomic situations in their plans in a deprived area like Hoveyzeh, Iran.

Keywords: *Cohort studies, diabetes, Iran, social determinants of health*

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Introduction

Diabetes is one of the most common endocrine disorders, defined by an abnormality in carbohydrate, protein, and fat metabolism.[1] The increased prevalence of type 2 diabetes is due to lifestyle changes, increasing obesity, urbanization, and aging of the population.[2] It is increasing rapidly in the world, especially in middle- and low-income countries, and is the cause of many deaths in these countries.[3,4] Diabetes is the seventh cause of death in the world, and according to the World Health Organization (WHO), the number of people with diabetes has almost increased fourfold since 1890 and reached 422 million people. It is expected to increase to 693 million people by 2045.[5,6] According to the estimate of the WHO, there were more than 2 million diabetic patients in Iran in 2000, and this number will exceed 6.4 million in 2030. Currently, about 5 million people in Iran have diabetes.[7] For several reasons, including the chronic nature of the disease, serious side effects such as increased heart attacks and strokes, kidney failure, blindness, and amputation, the effect on people of working age and low fertility, disability, and mortality, diabetes is considered a costly disease for the care system all over the world.[8] As such, investigations into factors contributing to the risk of diabetes and developing strategies to tackle the problem are required.

Since social factors affect people's health,[9] thus social-related factors also should be among other factors for risk assessment of diabetes. For instance, a study reported

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that people who were among deprived socioeconomic classes are more likely to get diabetes and nonadherence to preventive behaviors.[10,11] Therefore, countries that want to reduce their noncommunicable diseases to one-third by 2030 should increase their efforts to assess and address social and economic factors affecting health.[12] In this regard, different measures exist to evaluate people's economic and social status.[13-15] Different indices are used to determine the socioeconomic status (SES) in different countries; for example, in England, the job index is used;[16] in America, indices such as job, monthly income, consumption, and education level are used;[14-17] in Iran, the wealth (assets) index is used.[15]

Studies also have shown that a mixture of both individual-level factors such as level of physical activity and body mass index (BMI)[18] and physical activity[19,20] and social factors contribute to the risk of diabetes and its complications.[21,22]

All in all, it is necessary to comprehensively assess factors that contribute to the risk of diseases. As mentioned earlier, the social determinants of health approach are different from biomedical and behavioral descriptions. The role of social factors in various studies has mainly been investigated in developed countries;[23-25] furthermore, few studies have been conducted on social factors and their relationship with diabetes in developing countries like Iran. Therefore, this study was conducted to identify the social factors affecting diabetes in the population under a large cohort study in Iran. It is hoped that the results could fill the gap and assist the researcher and policymakers with evidence-based data on determinants of diabetes.

Methods

Study design and sampling

The present study is a cross-sectional analysis of the data from the Hoveyzeh cohort center, one of the sites of Prospective Epidemiological Research Studies in Iran (PERSIAN).[26]

The Hoveyzeh Cohort Study (HCS) is an ongoing prospective population-based cohort study of 10,009 adults (age 35–70 years) recruited from May 2016 to August 2018, designed to assess noncommunicable diseases in the southwest of Iran. Hoveyzeh is a deprived area 800 KM away from Tehran, the capital of Iran. Based on the 2016 door-to-door census, there were 7772 eligible individuals living in Hoveyzeh County: 4378 individuals in the two cities of Hoveyzeh and Rofayyeh (2187 males and 2191 females) and 3394 in 27 villages (1611 males, 1783 females). In addition, in 7 villages and two urban areas of Susangerd bordering Hoveyzeh, 4331 eligible people were invited. Before the project, several meetings were held with local authorities and trustees to familiarize them with the study's advantages and stages to increase local people's participation rate. Several lectures were held in public places such as mosques and cultural centers to introduce the PERSIAN Cohort Study, and pamphlets were distributed. Then, the census was conducted by local Red Crescent volunteers and sanitary inspectors. For this purpose, trained personnel recorded the required information of all eligible individuals. In addition, the geographical coordinates of each visited house were defined and recorded using the Garmin GPSMAP 78 s. Invitations to the cohort site were given by trained inviters 1 week before the referral day. A phone call reminded the invitees the day before the visit. Participants were transported daily to the cohort site by a minibus. Out of 12,103 eligible individuals invited, 8792 were enrolled in the study for the first stage, 982 for the second stage, and 235 for the third stage; thus, 10,009 individuals entered the study. The overall response proportion was 85.16%.[27] The study enrolled those who met the inclusion criteria using convenient sampling methods. The inclusion criteria were as follows: age ranges of 35–70, the absence of severe mental disorders, and being able to fill in the questionnaire. The desired information included the person's age, sex, marital status, education (illiterate and primary school, secondary school, high school diploma, and university), BMI, physical activity assessment using the metabolic equivalent of task (MET Index), Townsend deprivation index, and the ownership status of the household items such as television, car, fridge and other items concerning wealth status (wealth index).

The definition of diabetes

Diabetes is defined as fasting blood sugar equal to or more than 126 mg/dL or the use of blood sugar-lowering drugs by the participants under study.[28]

Assessment of socioeconomic factors

1. The Townsend deprivation index was used to calculate the social deprivation index. The Townsend deprivation index is an area-level indicator of SES, and this index was measured using variables (unemployment, car ownership, home ownership, and overcrowding).[12,29] Townsend deprivation index was calculated in four steps. (1) To calculate the percentage of households with noncar ownership, nonhouse ownership, unemployed adults, and overcrowding. (2) To calculate logged unemployed and logged overcrowding. (3) To calculate the Z score of no car, nonhomeowners, unemployed, and overcrowded. (4) To calculate the Z score of no car + Z score of nonhomeowner + Z score of unemployed + Z score of overcrowding = Townsend deprivation scores in the index were classified from the most affluent to the most deprived
2. The wealth index was calculated using the assets owned by a person including refrigerator, freezer, television, motorcycle, mobile phone, car, vacuum cleaner, internet access, washing machine, computer, home ownership, and the number of rooms). A coefficient

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was assigned to each of the assets. Then, the wealth index was extracted from the total scores, and finally, the wealth index was classified into the poorest to the wealthiest categories.[30]

Covariates

Age, gender and BMI were covariates. BMI is defined as a person's weight in kilograms divided by the square of the person's height in meters (kg/m^2). A BMI below 18.5 is underweight, while the healthy range is 18.5–24.9, 25.0–29.9 is overweight, and more than 30 is considered obese.[31] and has been used in previous studies.[32,33]

Physical activity

To measure participants' physical activity, the International Physical Activity Questionnaire was used in this cohort. The validity and reliability were found to be satisfactory; content validity index = 1, content validity ratio = 1, and Cronbach's alpha = 0.9. The questionnaire included questions about activity at work, housework, and exercise.[27,34] The MET Index was calculated to express the intensity of physical activities. MET is the ratio of a person's working metabolic rate relative to their resting metabolic rate. One MET is the energy cost of sitting quietly, equivalent to a caloric consumption of 1 kcal/kg/h. The daily physical activity questionnaire measured MET for all participants' activities 24 h a day, and quartiles were calculated for all participants.[35]

Statistical analysis

Descriptive statistics were performed using Mean and Standard deviation for quantitative variables, while frequency and percentage were used for categorical variables. The normality of data was checked using the Shapiro–Wilk test and was normally distributed. The proportions were compared using the Chi-square test. To explore the factors affecting diabetes, bivariate logistic analysis was performed with demographic variables: age, education, marital status, wealth, Townsend, and BMI were significantly associated with diabetes. In the next step, variables associated with diabetes in the bivariate analysis with $P < 0.25$ were entered into a backward stepwise logistic regression model. Data were analyzed using SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). $P < 0.05$ at the final stage was considered statistically significant.

Ethical consideration

Ahvaz Jundishapur University of Medical Sciences approved this study with the code of ethics: IR.AJUMS.REC.1398.275 and project number HCS-9808. This study has been performed following the Declaration of Helsinki, all participants and their informants gave their written informed consents in the original study. We confirm that all methods were performed following the relevant guidelines and regulations.

Results

In all, 10,009 adults with age ranges of 35–70 years participated in the study. Of whom, 2226 were diabetic and 7783 were nondiabetic. The results showed that 39.7% of men and 60.3% of women had diabetes. Furthermore, 67.7% of diabetic people were illiterate. The married category was found in 85% of diabetic people and 88.2% of nondiabetic people. The largest age group of diabetic people (32.6%) was 55–59. The majority of diabetic people (72.7%) were unemployed. Some people with abnormal weight (with a BMI higher than or lower than normal) also had diabetes (82.7%). Some diabetic people were among the deprived or the most deprived in terms of the Townsend social deprivation indicator (49.1%). Several diabetic people were among the poorest regarding the wealth index (39.2%).

There was no statistically significant relationship between gender and diabetes ($P > 0.05$). Still, there is a significant statistical relationship between age category, education, marital status, BMI, Physical activity, Townsend deprivation, and wealth index with diabetes ($P < 0.05$) [Table 1].

Results of multiple logistic regression model

After adjustment for significant variables in univariate analyses, multiple logistic regression model results indicated no statistically significant relationship between wealth Index and education and diabetes and significant associations between age category, physical activity, BMI, and Townsend deprivation index $P < 0.05$. The chance of diabetes increases with age. Thus, the chance of diabetes in people over 65 years old is 5.4 times that of people 35–40 years old. Increasing physical activity reduces the risk of diabetes. The chance of diabetes in people with less physical activity is 1.6 times higher than in people in the fourth quartile of physical activity. Compared with the underweight group, the chance of diabetes increases in the group with a BMI over 30 (odds ratio [OR] = 3.25; 95% confidence interval [CI] = 1.92–5.47). With the decrease in the Townsend deprivation index, the chance of diabetes increases (OR = 1.39; 95% CI = 1.21–1.60). The results are presented in Table 2.

Discussion

The present study aimed to identify social factors affecting diabetes in the population covered by a cohort study in Iran. The findings showed that age, physical activity level, BMI, and wealth status are related to diabetes status.

Concerning age, the current study showed that people with higher age are more likely to develop diabetes, a similar finding has been reported earlier.[36] In contrast, a study reported no statistically significant relationship between age and diabetes.[37] One possible explanation for such a difference might be due to the different age ranges enrolled in the study.

BMI is one of the factors affecting diabetes. A statistically significant relationship with diabetes was found in this

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Table 1: Demographic characteristics of the study population

	All, *n* (%)	Diabetic (*n*=2226), *n* (%)	Nondiabetic (*n*=7783), *n* (%)	*P*
Age group				
35–39	1912 (19.1)	177 (8.0)	1735 (22.3)	<0.001*
40–44	2025 (20.2)	289 (13.0)	1736 (22.3)	
45–49	1797 (18.0)	383 (17.2)	1414 (18.2)	
50–54	1482 (14.8)	394 (17.7)	1088 (14.0)	
55–59	1281 (12.8)	431 (19.4)	850 (10.9)	
60–64	798 (8.0)	287 (12.9)	511 (6.6)	
≥65	714 (7.1)	265 (11.8)	449 (5.7)	
Marital status				
Single	1249 (12.5)	333 (15)	916 (11.8)	<0.001*
Married	8760 (87.5)	1893 (85)	6867 (88.2)	
Education				
Illiterate and primary school	7874 (78.6)	1834 (82.4)	6040 (77.6)	<0.001*
Secondary school	673 (6.7)	113 (5.1)	560 (7.2)	
High school diploma	741 (7.4)	152 (6.8)	589 (7.6)	
University	721 (7.3)	127 (5.7)	594 (7.6)	
Gender				
Male	4026 (40.2)	883 (39.7)	3143 (40.4)	0.544
Female	5983 (59.8)	1343 (60.3)	4640 (59.6)	
BMI				
Normal	7766 (77.6)	384 (17.3)	1859 (23.9)	<0.001*
Abnormal	2243 (22.4)	1842 (82.7)	5924 (76.1)	
MET				
Q1	2503 (25.0)	784 (35.2)	1719 (22.1)	<0.001*
Q2	2503 (25.0)	557 (25.0)	1948 (25.0)	
Q3	2508 (25.01)	473 (21.3)	2035 (26.2)	
Q4	2493 (24.09)	412 (18.5)	2081 (26.7)	
Wealth by category				
Poorest	2000 (20.0)	424 (19.0)	1576 (20.2)	0.031*
Poor	2033 (20.3)	415 (18.6)	1618 (20.8)	
Moderate	1982 (19.8)	450 (20.3)	1532 (19.7)	
Affluent	2023 (20.2)	457 (20.5)	1566 (20.1)	
Most affluent	1971 (19.7)	480 (21.6)	1491 (19.2)	
Townsend				
Most affluent	2390 (23.9)	675 (30.3)	1715 (22.0)	<0.001*
Affluent	1856 (18.5)	447 (20.1)	1409 (18.1)	
Moderate	1890 (18.9)	375 (16.8)	1515 (19.5)	
Deprived	1293 (12.9)	233 (10.5)	1060 (13.6)	
Most deprived	2580 (25.8)	496 (22.3)	2084 (26.8)	

**P*-value (derived from Chi-square tests). BMI: Body mass index, MET: Metabolic equivalent of task

study, which has been seen in other studies,[28,38] which is consistent with the present study. Level of physical activity is found to be associated with diabetes. This aligns with a previous study. However, different result has been seen in research. In the study conducted in Birjand, Iran, the result showed no statistically significant relationship between physical activity and diabetes. This difference can be due to the selection of the age group over 60 years in this study.[39]

The wealth index of the people played a role in the incidence of diabetes in the present study; in this way, people who were in the lower socioeconomic groups had a lower chance of developing diabetes, and people who had a better SES had a higher chance of developing diabetes. This finding is inconsistent with previous studies conducted in developed countries.[40-42] However, studies indicate that deprivation is a risk factor for developing diabetes in developed countries; the current study showed that deprivation could be a protective factor in this cohort study conducted in Iran – a low- and middle-income country.[43] The current result is consistent with studies conducted in low-level income countries.[44,45]

Limitations

Among the limitations of the project, it can be mentioned that the study was conducted in one geographical area, and it is suggested to conduct and compare multi-continental

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Table 2: Multiple logistic regression analysis for the assessment of factors affecting diabetes

Variable	COR (95% CI)	AOR (95% CI)*	*P*
MET			
Q1	2.30 (2.01–2.64)	1.61 (1.39–1.86)	<0.001
Q2	1.44 (1.25–1.66)	1.23 (1.06–1.43)	0.005
Q3	1.17 (1.02–1.39)	1.11 (0.95–1.29)	0.16
Q4	1	1	
Townsend index			
Most affluent	1.65 (1.45–1.89)	1.39 (1.21–1.60)	<0.001
Affluent	1.33 (1.15–1.54)	1.25 (1.08–1.46)	0.003
Moderate	1.04 (0.89–1.21)	0.98 (0.84–1.14)	0.82
Deprived	0.92 (0.77–1.10)	0.93 (0.78–1.11)	0.46
Most deprived	1	1	
Age group			
35–39	1	1	<0.001
40–44	1.63 (1.34–1.99)	1.61 (1.31–1.96)	<0.001
45–49	2.66 (2.19–3.22)	2.61 (2.16–3.17)	<0.001
50–54	3.55 (2.93–4.31)	3.42 (2.81–4.16)	<0.001
55–59	4.97 (4.09–6.03)	4.72 (3.88–5.75)	<0.001
60–64	5.50 (4.45–6.80)	5.14 (4.14–6.39)	<0.001
≥65	5.78 (4.65–7.19)	5.4 (4.3–6.77)	<0.001
BMI			
Below 18.5	1	1	
18.5–24.9	1.60 (0.96–2.69)	1.91 (1.13–3.23)	<0.001
25–29.9	2.34 (1.40–3.89)	2.94 (1.74–4.95)	<0.001
≥30	2.55 (1.53–4.25)	3.25 (1.92–5.47)	<0.001

**P*-value<0.05 significant in multiple logistic regression. AOR: Adjusted odds ratio, COR: Crude odds ratio, BMI: Body mass index, MET: Metabolic equivalent of task, CI: Confidence interval

research in this regard. Furthermore, the study participants were in the age group between 35 and 70 years, so the results cannot be generalized to age groups outside this range. The study enrolled all those who met the inclusion criteria. The sampling method was convenient. The participation of women was more than men. As such, the results should be interpreted with caution. Future studies should determine how culture, access, availability, and affordability of healthy lifestyle choices contribute to the prevalence of diabetes in deprived areas.

Conclusion

The findings showed that the risk for diabetes is increased with older ages, lower physical activity levels, higher BMI, and higher social class. Future studies are needed to confirm such an observation. Perhaps social class might play different roles in low-, middle-, and high-income countries. Health promotion interventions to reduce diabetes should incorporate socioeconomic situations in their plans in a deprived area like Hoveyzeh, Iran.

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Conflicts of interest

There are no conflicts of interest.

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