

Transition in public knowledge of risk factors of cardiovascular disease in an Iranian general population: A latent transition analysis (LTA) on a longitudinal large community-based educational prevention program

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Original Article

Abstract

BACKGROUND: Cardiovascular diseases (CVD) are the second leading cause of death, after accidents, in Iran. This study was performed to assess the change in levels of knowledge about 8 risk factors of CVD and its associated determinants the Iranian general population.

METHODS: The current repeated cross-sectional study included 3014 people in 2004, 3012 in 2005, and 4719 in 2007, aged older than 19 years. Knowledge about 8 risk factors (high blood pressure, nutrition, physical inactivity, smoking, diabetes, heredity, stress, and obesity) as the major causes of CVD was evaluated using latent transition analysis (LTA).

RESULTS: The most widely known CVD risk factors were nutrition and physical inactivity followed by stress. In addition, old age, low level of education, male gender and low socioeconomic status (SES) level were the significant determinants of low knowledge levels of CVD risk factors. Besides, individuals' knowledge of CVD risk factors increased across the time.

CONCLUSION: Public knowledge of CVD risk factors has increased; however significant gaps continue to exist, particularly among the elderly, less-educated people, people in low socioeconomic status level and men. Future intensified educational efforts by policymakers are necessary for improving knowledge of CVD, particularly among high-risk groups.

Keywords: Cardiovascular Disease, Risk Factors, Prevention, Knowledge, Latent Transition Analysis

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Introduction

Cardiovascular diseases (CVD) are the leading cause of mortality and morbidity all over the world.^{1,2} According to World Health Organization (WHO) reports, it is estimated 17.3 million people became dead from CVDs in 2008 and it is predicted that almost 23.3 million people will die annually from CVDs, by 2030.³ CVD remains the first cause of preventable death globally and continues to grow in prominence, because of attendant burden, inequalities, and costs.² CVD is responsible for a considerable proportion of mortality and morbidity among Iranian general population; in which according to Iran ministry of health, CVD is the second leading cause of mortality and morbidity after accident and WHO is predicted that 44.8% of incidence of mortality will be related to it by 2030.^{3,4}

Prevention of CVD is the most effective way of combating the CVD epidemic in the less-developed

and developing nations. Knowledge of modifiable risk factors of CVD particularly in life style domain has been identified as a prerequisite for change in behaviour and is often targeted by prevention programs.^{5,6} Although, knowledge alone is not sufficient, it is assumed to be a key component of behavioural change decision making, and provides cues for action. Earlier studies have revealed that the education programs were effective in improving health promotion knowledge and behaviours.

It is clear that the knowledge and identification of risk factors for CVD, with early detection, can play an important role in controlling the symptoms, complications, and deaths, and decrease their health burden.^{5,7}

Although the level of knowledge of risk factors for CVD varies among different populations over the world; however the majority of the studies conducted in this area has reported low levels of knowledge.⁸⁻¹⁶

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Some limited studies carried out in Iran about the levels of knowledge of the CVD and its risk factors among Iranian general or specific population showed that the knowledge levels are poor.¹⁷⁻²³

In Iran, there is lack of large population-based studies on evaluating the distribution of knowledge levels about major risk factors of CVD and its determinants. Due to the expansion of CVD and its large burden, in a developing society such as Iran, implementing such monitoring study can provide effective prerequisites for change, conducting and improving the prevention programs. Therefore, the present study was conducted to assess not only the current but also the trend of changes over the 2004-2007 in levels of knowledge about CVD risk factors and related determinants in large samples of general public in Isfahan city and suburbs, using data obtained from a large-population, community-based intervention follow-up study, i.e. Isfahan Healthy heart program (IHHP),^{24,25} using an advanced statistical method i.e. latent transition analysis (LTA).²⁶ To our knowledge, the current study is not only the first large community-based study in Iran but also all around the world that examines the impact of a health-promotion educational intervention community-based program longitudinally using a relevant and comprehensive statistical modelling approach. LTA enables us to examine sequential stage movements in levels of knowledge and LTA with covariates also can provide the capability for examining the effects of potential determinants of participant's status in terms of knowledge levels about CVD risk factors. Estimating the level of knowledge of the population can help to promote the public health programs especially those directed towards reducing modifiable risk factors of CVD.

Materials and Methods

This panel or cross-sectional time-series study was conducted in an explanatory and correctional setting among general population living in Isfahan, the biggest province in central Iran, within the framework of IHHP.^{25,26} IHHP is a comprehensive integrated community-based intervention program targeted toward prevention of CVD risk factors and heart diseases was conducted in 4 phases started from 2001. Three cities (Isfahan, Najafabad and Arak), all located in central Iran, were contained in the study. Five independent cross-sectional surveys, in 2002, 2003, 2004, 2005 and 2007, were performed in three areas at the same time, addressing mainly the community knowledge,

attitude and practice of CVD risk factors. In a multistage cluster sampling method, individuals aged ≥ 19 years were randomly selected. Inclusion criteria were as aged 19 years and over and Iranian citizenship that at least 6-month residence in the area of the study. Exclusion criteria were as pregnant, prior history of mental disorders, mental retardation and physical disability. Written informed consent was obtained from individuals, prior to participating in the study. The Ethics Committee of the Isfahan University of Medical Sciences approved the IHHP study. More details about IHHP study design, sampling strategy and studied variables can be found elsewhere.^{24,25}

In current study, the data obtained from Isfahan in 2004, 2005 and 2007 were used. The studied sample sizes for Isfahan were 3014, 3012, and 4719 in those three sections (2004, 2005 and 2007), respectively. Despite the studied samples in this study were independent, however considering the IHHP as the community-based intervention program, we considered them as the same sample that their levels of knowledge sequentially were evaluated over the study periods.

To assess the knowledge of CVD risk factors, a questionnaire consisted of 8 questions regarding "knowledge of people about well-known risk factors of CVD" was used. Respondents were asked to indicate which one of the following items is a risk factor for CVD "high blood pressure", "nutrition", "physical inactivity", "smoking", "diabetes", "heredity", "stress", and "obesity". The response categories for the questions were as "correct", "wrong", and "I don't know". Each question was assigned a score of 0 for wrong answer (individual marked "I don't know" or marked "wrong" options) and 1 for correct answer (individual marked "correct"). Our questionnaire was structured according to well-known CVD risk factors identified by American Heart Association and content validity of questionnaire items was examined by the clinical experts via peer reviewing.¹³

Other studied variables in the current study that played the role of potential determinants of status of participants in terms of knowledge levels were as gender, age, education [three categories i.e. not-educated, less than diploma or diploma (12 years formal education) and university graduated], marital status (married and single), and socioeconomic status (SES). SES was considered as a latent variable, and was constructed using latent class analysis techniques,²⁶ with two classes (high or low SES) based on four indicator variables i.e.

ownership of a house, car, personal computer, and health insurance support. Membership in each constructed class showed the status of SES.

To analyse the level of “knowledge” about the CVD risk factors and changes over time as well as its determinants, LTA was used. LTA is a version of latent class analysis (LCA) used in longitudinal data to model transitions in latent class membership over time. LTA enables the investigator to address an additional set of questions about changes between latent classes across time, how can this change be characterized, the probability that the individual will remain in the same latent class at time $t + 1$, and the probability that the individual will be in a different latent class at the next time.

As an application of LTA, in this study, the overall knowledge about the risk factors of CVD as the categorical latent class variable was constructed based on multiple dichotomous observed indicators including being aware of high blood pressure, diabetes, obesity, physical inactivity, heredity, stress, smoking, and nutrition. LTA with covariate approach was used to determine the impact of potential determinants including age, gender, education level, marital status and socioeconomic status on knowledge level. All descriptive and analytical analyses in the present study were performed in R free statistical software, version 3.1.3 (R Foundation for Statistical Computing, Stanford University, CA, USA).

Results

Sociodemographic characteristics

Respondents in this study included 3014 people in first, 3012 in second, and 4719 in the third stage, aged 19 years or more. The average age of participants was

42.40 (\pm 0.31) years. Slightly more than half of the respondents (50.6-51.7 percent) were women and the rest (48.2-49.3 percent) were men. The majority of the respondents [77.0 percent (75.9-78.1)] were married. Most of the people included in the study [85.1 percent (80.2-90.4)] had diploma or less than 12 years of formal education and 32.0 percent (19.0-39.0) of individuals were in high socioeconomic status (according to results of latent class analysis).

Knowledge about the specific CVD risk factors

Table 1 shows the prevalence of correct answers to the questions about CVD risk factors in study sample. Among the 8 risk factors, the most widely known factors were nutrition and physical activity, followed by stress, blood pressure and obesity. In contrast, the knowledge about diabetes was low compared to other risk factors. Factors, such as heredity and smoking ranked between the high and low fractions. On average, the level of correct knowledge in both genders was comparable, and prevalence of correct answers increased across time.

Evaluation of the overall knowledge level about the CVD risk factors and its determinants

To analyse the overall level of knowledge about the CVD risk factors and its determinants, using LTA, we constructed latent statuses of the respondents based on knowledge about each of the 8 dichotomous variables as having knowledge or lack of knowledge and evaluated transitions between statuses across the considered study periods. We first fitted a LTA model without covariates, with different number of statuses (2-5 statuses) to find the appropriate number of statuses to have the best fit and the most interpretability of the results. Accordingly, a model with three latent statuses

Table 1. Prevalence (%) of correct knowledge about the cardiovascular diseases (CVD) risk factors*

Risk factor	Time 1 (2004)				Time 2 (2005)				Time 3 (2007)			
	Women	Men	Total	95%CI	Women	Men	Total	95%CI	Women	Men	Total	95%CI
Blood pressure	71	66	68	67-70	70	71	70	69-72	82	80	81	80-82
Diabetes	39	36	38	36-39	35	35	35	34-37	40	39	39	38-41
Nutrition	83	82	83	81-84	79	80	80	78-81	89	88	89	88-90
Physical inactivity	82	81	82	80-83	81	81	81	80-82	88	89	89	88-90
Smoking	44	45	44	42-46	48	52	50	48-52	52	56	54	53-56
Heredity	50	46	48	46-50	56	52	54	52-56	71	68	70	68-71
Obesity	62	72	67	65-69	66	65	65	64-67	60	66	62	60-63
Stress	78	71	74	73-76	78	74	76	75-78	87	88	88	87-88

* The amounts are percentages of correct answers (knowledge).
95%CI: 95% confidence interval

Table 2. Item-correct response probabilities

Risk factor	Time 1 (2004)			Time 2 (2005)			Time 3 (2007)		
	Status 1	Status 2	Status 3	Status 1	Status 2	Status 3	Status 1	Status 2	Status 3
Blood pressure	0.0439	0.4895	0.9460	0.3265	0.6159	0.9064	0.3349	0.5433	0.9790
Diabetes	0.7499	0.2576	0.7409	0.8403	0.3216	0.7577	0.8947	0.5501	0.5649
Nutrition	0.9469	0.2883	0.9168	0.9114	0.4646	0.9195	0.9360	0.3457	0.9621
Physical inactivity	0.9469	0.2586	0.9081	0.9025	0.4590	0.9364	0.9597	0.4212	0.9581
Smoking	0.1244	0.2568	0.5914	0.0570	0.3609	0.7622	0.2071	0.3742	0.6860
Heredity	0.1891	0.2423	0.4697	0.0715	0.3288	0.5088	0.1385	0.3029	0.4729
Obesity	0.3543	0.1969	0.5884	0.7220	0.3254	0.5895	0.7492	0.3410	0.7128
Stress	0.6304	0.3131	0.8864	0.8659	0.4086	0.8923	0.9437	0.6257	0.9014
Latent status prevalence	0.21	0.15	0.63	0.22	0.27	0.52	0.17	0.11	0.71

was chosen (Log-likelihood:-44755.89, G-squared: 27889.69, AIC: 28061.69, BIC: 28617.19, and Degrees of freedom: 16777129).

Then, covariates were entered into the model. Table 2 shows the prevalence of correct answers to the questions on CVD risk factors in constructed statuses at each three evaluation times. Each status can be interpreted in terms of level of knowledge about the CVD risk factors. According to prevalence of correct responses reported in table 2, over the all study periods, status 3 can be considered as the high knowledge levels class; because as can be seen, this status included higher percentages of correct answers about all studied items in comparison with other statuses; while, status 2 can be considered as the class of people with poor knowledge levels about the majority of the studied risk factors. Status 1 is the class of persons who were knowledgeable about some special risk factors such as nutrition, physical activity, diabetes and stress.

In the lower part of table 2, the prevalence of latent status membership is shown. It can be seen that the prevalence of status 3 across all times are more than other statuses; it means that the most of individuals in this study had a high level of knowledge about CVD risk factors.

Changes in knowledge level about the CVD risk factors and its determinants

Table 3 shows the transition probabilities across the study periods. From time 1 to 2, two transition probabilities showed minor differences, while marked difference was observed from time 2 to the third stage in which it is more likely to transition into higher levels of knowledge class. According to transition probabilities, it can be inferred that the individuals' knowledge levels about risk factors of

CVD have been increased across time.

Table 3. Latent transition probabilities

Probability of transitioning to...	..time 2 latent status	..time 2 latent status		
		Status 1	Status 2	Status 3
Conditional on time 1 latent status	Status 1	0.2060	0.2751	0.5189
	Status 2	0.2295	0.3363	0.4342
	Status 3	0.2144	0.2490	0.5366
Probability of transitioning to...	..time 3 latent status	..time 3 latent status		
		Status 1	Status 2	Status 3
Conditional on time 2 latent status	Status 1	0.1477	0.1179	0.7344
	Status 2	0.1678	0.1165	0.7157
	Status 3	0.1778	0.1099	0.7124

Table 4 shows the regression coefficients, odds ratios of covariates and their significant levels. Considering latent status 3 as the reference response category, it can be seen that the men (OR = 1.49), single individuals (OR = 1.91), individuals with low levels of SES (OR = 2.49), older people (OR = 1.02), and less-educated people (OR = 1.22 and 1.26), were more likely for being in lower levels of knowledge (i.e. being in latent status 2 and latent status 1).

Discussion

In this study, we assessed the level of knowledge about the CVD risk factors and its transitions across time and evaluated its association with some potential determinants in a general population of Isfahan and suburbs, using an advanced statistical analysis method i.e. LTA. Among the 8 risk factors, the most widely known CVD risk factors were nutrition and physical inactivity. The American Heart Association has recently focused on lack of physical activity as a major modifiable risk factor for heart disease.²⁷

Table 4. Estimations of the covariates coefficient (factors associated with knowledge level) reflecting their impact on latent status of membership in time 1

Risk factor	B		Odd's ratio (OR)		P
	Status 1	Status 2	Status 1	Status 2	
Age	-0.0013	0.0246	0.9987	1.0249	0.000002
Sex (Reference: Women)	0.4928	0.4013	1.6369	1.4937	0.000043
Education (Reference: university graduation)					0.001597
Less than diploma or diploma (12-year formal education)	0.55535	0.1554	1.7393	1.1681	0.041221
Not educated	0.8416	0.2372	2.3201	1.2676	
Marital status (Reference: Married)	0.3897	0.6518	1.4766	1.9190	0.000198
Socio-economic status (Reference: high level)	0.8076	0.9163	2.2425	2.4999	<0.000001

The next known risk factor in our study was stress. The relatively higher knowledge about stress as CVD risk factor in our society can be attributed, in part, to the increasing prevalence of stress.²⁷

However, as can be seen from tables 1 and 2, the current study showed poor knowledge about some key risk factors of CVD such as diabetes, heredity and smoking among the studied population. In addition, for some other important risk factors such as high blood pressure and obesity the knowledge levels were moderate i.e. slightly more than 60% of study sample could correctly identify them as a CVD risk factor.

The lowest level of knowledge in our study was observed about diabetes. According to assessment of the American Heart Association about CVD risk factors, women with diabetes are classified as at high risk of developing CVD and in men, diabetes is correlated with a twofold to threefold increase in heart disease.²⁷ This finding emphasizes the conducting community-based public educational programs on the raising knowledge and management of diabetes in order to prevent CVD.

About blood pressure, smoking and obesity, however our findings showed low levels of knowledge of majority of these pathogenic risk factors of CVD, that it can be linked to low rates of blood pressure and obesity control among the studied population.²⁸ These findings provide an implicit knowledge-based objective framework through implementation of effective public education programs in order to diminish CVD modifiable risk factors using change and modification in lifestyle.

To determine the predictors of status membership in terms of knowledge levels at the first stage of study, LTA with covariate was conducted. Men were less likely than women

participants to have high levels of CVD risk factor knowledge, independent of education level. Besides, as it was anticipated, in the current study, we found that more-educated participants had higher knowledge about CVD risk factor than less-educated ones. The observed gender and educational attainment levels differences in terms of knowledge about CVD risk factors can be associated with more contributing in the prevention actions or getting more information in women and higher educated people. Therefore, considering these findings, substantial gap remains in prevention programs assessing specific cardiovascular knowledge in men and less educated people and preventive action taken.

Considering that the incidence of CVD increases rapidly with age, the knowledge disparity among elderly people needs to be addressed in programs aimed at helping them to recognize and take enhancement treatment-seeking action through simple and effective guidelines. Our study showed that lower levels of SES are positively associated with a lower CVD risk factors knowledge.

Conclusion

The findings of this survey, based on a reliable and comprehensive statistical modelling approach specified to evaluating the changes across time in knowledge levels, demonstrated that although the public knowledge of CVD risk factors relatively improved in the Isfahan region between 2004 and 2007; however, knowledge about some important risk factors such as smoking, diabetes, heredity and obesity remained relatively constant. Although, public knowledge of CVD risk factors has increased, that partly can be attributed to the impacts of IHHP public intervention education programs, but

significant gaps continue to exist, with lack of knowledge most apparent regarding key risk factors particularly among the elderly, men, less-educated and low-SES people. Future intensified educational efforts are necessary to promote knowledge of CVD, particularly among high-risk groups, by policymakers, as well as local and national organizations.

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Conflict of Interests

Authors have no conflict of interests.

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