Association of food insecurity with myocardial infarction: a case-control study

Sanaz Soltani[1], Ahmad Reza Dorosty Motlagh[2], Fereydoun Siassi[3], Manoochehr Babanezhad[4], Mostafa Qorbani[5], Azadeh Aminianfar[1], Ali Cheraghi[1]

[1] MSc in Nutritional Sciences, Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran; [2]Professor, Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran, E-mail: dorostim@tums.ac.ir; [3]Professor, Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran; [4]Associate Professor, Department of Statistics, Faculty of sciences, Golestan University, Gorgan, Golestan, Iran; [5]Assistant professor, Noncommunicable Disease Research Center, Alborz University of Medical Sciences, Karaj, Iran

Summary. *Objective:* There is a little evidence about association of cardiovascular diseases and food insecurity. This study was designed to examine the association of food insecurity and myocardial infarction (MI) in a sample of newly diagnosed cases in northern Iran. *Methods:* In this frequently matched case control study, 100 new MI cases (incident case) as a case group were compared with 100 persons as a control group matched by age, sex, and area of residence. Eighteen-item household food security questionnaire which is designed by United States Department of Agriculture (USDA) was used for assessing of food insecurity. The collected data was analyzed using Stata software by Logistic regression model. *Results:* After adjusting for the potential confounder variables including education, family history of MI, hypertension and smoking, multivariate logistic regression model showed that food insecurity was significantly associated with MI (OR=1.23, 95% CI: 1.09-1.40, P=0.001). *Conclusions:* The present study has shown that food insecurity is a significant predictor of MI and the odds of MI in food insecurity is higher than food secure cases.

Keywords: Case control Study, Food insecurity, Myocardial Infarction

Introduction

The Millennium Development Goals (MDGs) are eight international development goals to be achieved by 2015 (1). One of the main objectives of MDGs is poverty reduction (2), particularly, Sustainable Development Goals 2 (SDG2) which is projected by the Open Working Group calls for finishing hunger, achieve food security and improved nutrition, and promote sustainable agriculture (2).

Food security exists when all people at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (3,4). According the report of the Food and Agricul-

ture Organization (FAO), about 795 million people in the world (with prevalence rate of 10.9%) were estimated to be undernourished in 2014–16; of which, 779.9 million live in developing region and 14.7 million in developed regions. A majority of 18.9 million of them live in Western Asia (5).

Cardiovascular disease (CVD) is the main cause of death worldwide (6,7). Due to the "Global Burden of Disease study in 2010" estimation, nearly 30% of all deaths worldwide were caused by CVD (8). CVD is also the frequent cause of death in Iran (9) and it is cause of more than 40% of death in Tehran, capital city of Iran (10). When reviewing the literature, there is a little evidence about association of CVD with food insecurity. For example Ford in his cross sectional study

(11), found that people with low food security have an evidence of increased risk of 10-year cardiovascular disease. On the other hand, there is some evidence for association of food insecurity with CVD risk factors including hyperlipidemia, hypercholesterolemia, high blood pressure, smoking and blood glucose (12-16). Therefore, this study was aimed to assess the association of food insecurity with myocardial infarction (MI) in newly diagnosed cases in northern Iran.

Materials and methods

Participants

This was a frequently matched case-control study performed in Mazandaran, a province in the North of Iran. In this study, frequency matching was conducted by age, sex, and area of residence between case and control groups.

Our study population included 86 men and 14 women in both case and control groups. Participants as a case group included men and women with the first occurrence (incident cases) of MI admitted to hospitals such as Imam Reza in the city of Amol, Ayatollah Rouhani in the city of Babol, and Fatima Zahra in the Sari city. Subjects referred to the outpatient clinics, physiotherapy, and health center without cardiovascular disease, diabetes, hyperlipidemia, hypertension, and other conditions that lead to a change in usual diet or lack of recalling consumable diet were considered a control group. Inclusion criteria were lack of a history of cardiovascular disease, diabetes, hyperlipidemia, hypertension, having any special diet in the last 2 months, and any disease leads to a lack of reminders (such as Alzheimer). Lack of contribution by the end of questioning was the exclusion criterion. The sample size for each group (with type one error 0.05 and power of 80 %) was estimated about 100 patients considering a pilot study conducted on 20 patients with a first MI as the case group and 20 healthy subjects as controls in which prevalence of food insecurity in case and control group were estimated 0.50 and 0.25 %, respectively.

General Information and the status of food insecurity were investigated using public questionnaires of general demographic characteristics, and socioeconomic factors and household food insecurity, including 18 items attributed to the United States Department of Agriculture (USDA) (17), respectively. In this study, to assess food security, the questionnaire used was USDA (18 items), which in previous studies has been validated in Iran (18-20). This tool investigates household food insecurity in the past 12 months. In this study, the questionnaires were completed by interview. Based on the method of Gray Bickel et al. (21), scores were assessed. Body mass index (BMI) was the anthropometric measure that calculated by dividing the weight (in kilograms) by the square of the height (in meters). Body weight was measured to the nearest 100 grams by using a digital Seca scale. In addition, Height was measured to the nearest 0.5 centimeter in standing position by using a non-elastic measuring tape. According to voluntary participating, confidentiality and lack of any intervention were considered ethical issues.

Statistical methods

Categorical and continuous variables were summarized as n (%) and mean ± standard deviation (SD) respectively. Pearson chi-square tests and independent t-test were used to assess differences between baseline demographic and clinical characteristics. Principal Components Analysis (PCA) was applied to achieve an index as a proxy for patients' socio-economic status. Ownership of following asset was asked: house, car, refrigerator, dishwasher, washing machine, LCD TV, handmade carpet, notebook and microwave. Univariate and multivariate logistic regression model was used to examine the association of food insecurity with MI. In multivariate model, the association of food insecurity with MI was adjusted for variables which was significant in univariate model (education level, family history of MI, hypertension and smoking). Results of logistic regression are presented as odds ratio (OR) with 95 percent confidence intervals (CI).

In order to verify the proper scale for continuous variables, we used fractional polynomials suggested by Royston. For example, fractional polynomial showed that linear scale for food insecurity has the best fitting in the logistic model. Data was analyzed by using Stata software version 11 (Stata Corp, College Station, Tex, USA).

Results

Demographic variables of two groups are described in Table 1. As shown in this table, cases were significantly more likely to be current smokers (49% vs. 18%, p<0.001) and to have hypertension (24% vs. 8%, p=0.002) and positive family history of MI (43% vs. 9%, p<0.001). Controls had a significantly (p=0.014) higher education level compared to case group. There was no significant difference between two groups based on other demographic characteristics including age, BMI, gender, economic status and marital status.

Notably in this study, 92% of case group and also 91% of control group were married. It is found that the mean (± SD) of food insecurity score in married and single groups was 2.06 (±2.67) and 1.93 (±3.19), respectively, and the difference between these two groups is not significant from this perspective.

Our investigation shows that the mean (± SD) of food insecurity score in case group was 2.71 (±2.98), and this score was 1.38 (±2.24) in control group. In a univariate logistic regression analysis, food insecurity showed a significant association with MI (OR=1.21, 95% CI: 1.08-1.35, P=0.001). As showed in Table 2, after adjusting for the potential confounder variables by multivariate logistic regression model, approximately the same results were observed. In this model, food insecurity was significantly positive association with MI (OR=1.23, 95% CI: 1.09-1.40, P=0.001), adjusted for education, family history of MI, hypertension and smoking. According to the model, people were 1.23 times as likely to getting MI per 1 unit change in food insecurity score.

Discussion

In this study, a significant association was found between food insecurity and MI (P<0.001). After adjustment for confounding variables, the odds of MI increases 1.23 times as the food insecurity score increases per unit. There is no published report about association

Table 1. Baseline Characteristics of cases and controls

Variables		Case (n= 100)	Control (n= 100)	P-value
		(%)	(%)	
Age (year)		56.14 ± 11.17	55.12 ± 11.47	0.525
BMI (kg/m²)		26.33 ± 3.74	26.28 ± 3.30	0.922
Hypertension	Yes	24 (24)	8 (8)	0.002
	No	76 (76)	92 (92)	
Positive family history of MI	Yes	43 (43)	9 (9)	<0.001
	No	57 (57)	91 (91)	
Smoking	Yes	49 (49)	18 (18)	<0.001
	No	51 (51)	82 (82)	
Education level	Diploma	23 (23)	39 (39)	0.014
	Low literate	77 (77)	61 (61)	
Economic status	Poor	31 (31)	36 (36)	0.507
	Middle	26 (26)	29 (29)	
	Rich	43 (43)	35 (35)	
Marital status	Single	8 (8)	9 (9)	0.800
	Married	92 (92)	91 (91)	

Case= diagnosed with first–time myocardial infarction; control= adjusted healthy individuals
BMI= body mass index, MI= myocardial infarction
Data are given as mean ± SD or n (%).
Level of significance is set at ≤0.05

between MI and food insecurity. A review study by Drewnowski and Specter in 2004 showed that poverty and food insecurity are related to lower cost of food, low fruit and vegetable consumption, and lower-quality diets. Moreover, it was shown that a reduction in diet costs gives rise to a high-calorie diet (22). Hoddinott and Yohannes in 2002 revealed that the index of dietary diversity can be representing the household food security (23). Therefore, decrease of dietary diversity and increase of high-calorie and low-density nutrients, which can lead to food insecurity may increase the risk of MI.

In this investigation, a significant relationship was observed between the incidence of MI and smoking. The odds ratio was 5.47 times higher in smokers. Lanas et al. (1999-2003), Merry et al. (1987-1997), and Joshi et al. (1999-2003) suggested that Smoking is associated with increased risk of MI (24-26). Yusuf et al. (2004) showed that there was a positive and strong relationship between the number of cigarettes consumed per day and the risk of MI. In other words, the odds ratio of MI was 9.16 times higher in participants smoked more than 40 cigarettes per day than those who did not smoke (27). Several potential mechanisms including inflammation, endothelial dysfunction, impaired insulin sensitivity, and lipid abnormalities appear to contribute to the effects of smoking in accelerating atherosclerosis (28). Hence, there was a positive and significant relationship between smoking and MI. On the other hand, in a cross-sectional study on 10,455 people older than 20 years old in United States done by Ford (11), it was shown that as food security worsened, the prevalence of smoking increased. In addition, Armour et al. indicated that smoking was negatively related to household food security in a national sample of low-income families (29). Consequently, risk factors for the diseases such as smoking

can also lead to the incidence of MI due to their relationship with food insecurity.

This investigation also showed that there is a meaningful relationship between the risk of MI and family history of the disease. Roncaglioni also demonstrated that there was a significant relationship between the incidence of MI and a family history of the disease. The number of relatives and age at incidence were related to the strength of relationship (30). Lind et al. in 2014 indicated that a family history of MI was associated with the increased risk of the disease about 52%. Adjusted risk factors for atherosclerosis, such as hypertension, dyslipidemia, and diabetes, are influenced by genetic factors and lifestyle (31). Our findings also showed a strong association between a family history and the disease.

In this study, there was a significant relationship between the incidence of MI and a history of high blood pressure (P=0.001). The odds of MI was 15.5 times more in people with high blood pressure. Psaty et al. (2001) indicated that after adjustment for potential confounding variables, systolic blood pressure, diastolic blood pressure, and pulse pressure are directly associated with the risk of MI (32). High blood pressure can damage arteries and put pressure on the heart. It plays an important role in the incidence of MI. In a study by Seligman et al., food insecurity was associated with hypertension (33). Wolfe et al. in 2003 concluded that adults with food insecurity faced with the problem to provide food low-sodium alternatives (34). One of the probable causes of the increased risk of hypertension and MI was eating foods containing high sodium and lower potassium (less consumption of fruits and vegetables), may found in the diet of people with food insecurity.

This is one of the strengths of the present study that this was the first study focusing on the relation-

Table 2. Association of food insecurity with myocardial infarction in logistic regression analysis

Variables		OR	95% CI of OR	P-Value
Food insecurity score	Model I[1]	1.21	1.08-1.35	0.001
	Model II[2]	1.23	1.09-1.4	0.001

Model I: Crude model
Model II: Adjusted for education, family history of MI, hypertension and smoking

ship of food insecurity and risk of MI in Iran, and also the cases were the new case that leads to reduce some biases. We had only 100 cases in each group which might be considered as a limitation.

Besides the traditional risk factors, it has been found that food insecurity is related to the risk of MI. Therefore policy makers should pay special attention to this matter in their society to reduce food insecurity as part of the household concern about the provision of adequate food, in order to partly control the occurrence of MI.

Acknowledgments

Funding

Bibliografía

1. Lomazzi M, Borisch B, Laaser U. The Millennium Development Goals: experiences, achievements and what's next. Global health action. 2014;7.

2. Wichelns D. Achieving Water and Food Security in 2050: Outlook, Policies, and Investments. Agriculture. 2015;5(2):188-220.

3. FAO. Rome Declaration on World Food Security and World Food Summit Plan of Action; FAO: Rome, Italy, 1996. Available at: http://www.fao.org/docrep/003/w3613e/w3613e00.HTM

4. Clay E. Food security: Concepts and measurement. A Paper for FAO Expert Consultation on Trade and Food Security: Conceptualising the linkages. FAO, Rome. 2002.

5. FAO, IFAD and WFP. The state of food insecurity in the world. Meeting the 2015 international hunger targets: Taking stock of uneven progress. Rome: FAO, 2015. Available at: www.fao.org/3/a-i4646e.pdf.

6. Nichols M, Townsend N, Scarborough P, Rayner M. Cardiovascular disease in Europe 2014: epidemiological update. European heart journal. 2014;35(42):2950-9.

7. Nichols M, Townsend N, Luengo-Fernandez R, et al. European Cardiovascular Disease Statistics 2012. European Heart Network, Brussels, European Society of Cardiology, Sophia Antipolis, 2012. Available at: http://www.ehnheart.

org/downloads/1365.html.

8. Lozano R, Naghavi M, Foreman K, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet. 2013;380(9859):2095-128.

9. Esteghamati A, Meysamie A, Khalilzadeh O, et al. Third national Surveillance of Risk Factors of Non-Communicable Diseases (SuRFNCD-2007) in Iran: methods and results on prevalence of diabetes, hypertension, obesity, central obesity, and dyslipidemia. BMC public health. 2009;9(1):167.

10. Khalili D, Mosavi-Jarrahi A, Eskandari F, et al. Evaluation of cause of deaths' validity using outcome measures from a prospective, population based cohort study in Tehran, Iran. PloS one. 2012;7(2):e31427.

11. Ford ES. Peer Reviewed: Food Security and Cardiovascular Disease Risk Among Adults in the United States: Findings From the National Health and Nutrition Examination Survey, 2003–2008. Preventing chronic disease. 2013;10.

12. Seligman HK, Davis TC, Schillinger D, Wolf MS. Food insecurity is associated with hypoglycemia and poor diabetes self-management in a low-income sample with diabetes. Journal of health care for the poor and underserved. 2010;21(4):1227.

13. Seligman HK, Jacobs EA, Lopez A, Tschann J, Fernandez A. Food insecurity and glycemic control among low-income patients with type 2 diabetes. Diabetes Care. 2012;35(2):233-8.

14. Parker ED, Widome R, Nettleton JA, Pereira MA. Food security and metabolic syndrome in US adults and adolescents: findings from the National Health and Nutrition Examination Survey, 1999–2006. Annals of epidemiology. 2010;20(5):364-70.

15. Cutler-Triggs C, Fryer GE, Miyoshi TJ, Weitzman M. Increased rates and severity of child and adult food insecurity in households with adult smokers. Archives of pediatrics & adolescent medicine. 2008;162(11):1056-62.

16. Holben DH, Pheley AM. Peer Reviewed: Diabetes Risk and Obesity in Food-Insecure Households in Rural Appalachian Ohio. Preventing chronic disease. 2006;3(3).

17. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Household food security in the United States in 2010. Washington, DC: Economic Research Service, US Department of Agriculture. 2011.

18. Najafi B, Shooshtarian A. Targeting of subsides and elemination of food insecurity: case report of Arsanjan. Journal of Business Research. 2005;31:127-51.

19. Mohammadzadeh A, Dorosty A, Eshraghian M. Household food security status and associated factors among high-school students in Esfahan, Iran. Public health nutrition. 2010;13(10):1609-13.

20. Hakim S, Dorosty AR, Eshraqian MR. Relationship between food insecurity and some of socioeconomic factors with BMI among women in Dezfoul. Iranian Journal of School of Public Health. 2011;2: 55-66.

21. Bickel G, Nord M, Price C, Hamilton W, Cook J. Guide

to measuring household food security: revised 2000. Alexandria (VA): Department of Agriculture (US), Food and Nutrition Service. 2000.

22. Drewnowski A, Specter S. Poverty and obesity: the role of energy density and energy costs. The American journal of clinical nutrition. 2004;79(1):6-16.

23. Hoddinott J, Yohannes Y. Dietary diversity as a food security indicator. Food consumption and nutrition division discussion paper. 2002;136:2002.

24. Lanas F, Avezum A, Bautista LE, et al. Risk Factors for Acute Myocardial Infarction in Latin America The INTERHEART Latin American Study. Circulation. 2007;115(9):1067-74.

25. Merry AH, Boer JM, Schouten LJ, et al. Smoking, alcohol consumption, physical activity, and family history and the risks of acute myocardial infarction and unstable angina pectoris: a prospective cohort study. BMC cardiovascular disorders. 2011;11(1):13.

26. Joshi P, Islam S, Pais P, et al. Risk factors for early myocardial infarction in South Asians compared with individuals in other countries. Jama. 2007;297(3):286-94.

27. Yusuf S, Hawken S, Ôunpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. The Lancet. 2004;364(9438):937-52.

28. Centers for Disease Control and Prevention. How tobacco smoke causes disease: The biology and behavioral basis for smoking-attributable disease: A report of the surgeon general. Atlanta, GA: Centers for Disease Control and Prevention (US). 2010.

29. Armour BS, Pitts MM, Lee C-w. Cigarette smoking and food insecurity among low-income families in the United States, 2001. American journal of health promotion. 2008;22(6):386-92.

30. Roncaglioni MC, Santoro L, D'Avanzo B, et al. Role of family history in patients with myocardial infarction. An Italian case-control study. GISSI-EFRIM Investigators. Circulation. 1992;85(6):2065-72.

31. Lind C, Enga KF, Mathiesen EB, Njølstad I, Brækkan SK, Hansen J-B. Family History of Myocardial Infarction and Cause-Specific Risk of Myocardial Infarction and Venous Thromboembolism-The Tromsø Study. Circulation: Cardiovascular Genetics. 2014:CIRCGENETICS. 114.000621.

32. Psaty BM, Furberg CD, Kuller LH, et al. Association between blood pressure level and the risk of myocardial infarction, stroke, and total mortality: the cardiovascular health study. Archives of internal medicine. 2001;161(9):1183-92.

33. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. The Journal of nutrition. 2010;140(2):304-10.

34. Wolfe WS, Frongillo EA, Valois P. Understanding the experience of food insecurity by elders suggests ways to improve its measurement. The Journal of nutrition. 2003;133(9):2762-9.

————

Correspondence:

Ahmad Reza Dorosty Motlagh: Professor, Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, Tehran, Iran

Phone number: +982188955975

Email: dorostim@tums.ac.ir