



Association between secondhand smoke and glycemic control in adult diabetes patients



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ABSTRACT

Diabetes is a major chronic disease, and many studies have shown an association between diabetes with severe complications and certain causes of diabetes, including secondhand smoke. Smoking has been considered a significant issue around the world, and research has been conducted on its relationship with diseases including diabetes. However, previous studies have focused on the onset of diabetes, rather than glycemic control in patients with diabetes. Thus, this study aims to provide evidence of a relationship between secondhand smoke and glycemic control. We conducted a cross-sectional study using data from the Korea National Health and Nutrition Examination Survey (2007–2014). We included 1168 male and 1248 female survey participants. Exposure to secondhand smoke at home and/or at workplaces was considered the primary independent variable, and glycemic control was represented by HbA1c levels. Chi-squared tests and logistic regression analysis were performed to evaluate the association. A significant association was found between secondhand smoke and glycemic control (male at home, odds ratio [OR]: 0.36, 95% confidence interval [CI]: 0.14–0.90; female at both locations, OR: 0.29, 95% CI: 0.11–0.74). The sub-group analysis showed a negative association of diabetes management with secondhand smoke in both sexes, regardless of income status or healthy/unhealthy behaviors. Exposure to secondhand smoke at home was revealed as a risk factor for poor glycemic control. Thus, healthcare providers should help diabetes patients to avoid secondhand smoke by educating them on the dangers of secondhand smoke.

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1. Introduction

Diabetes is a prevalent chronic disease and is a major health concern because it can lead to cardiovascular diseases, blindness, kidney failure, or complications requiring amputation of the foot (Afkarian et al., 2013; Rydén et al., 2013; O'Rourke et al., 2012). In Korea, mortality rate of diabetes exceeded 20 per 100,000 people since 1998, and currently it is within the top 10 cause of mortality (Statistics Korea, 2016a). Fortunately, diabetes is strongly associated with lifestyle and its progression can be managed by the patient themselves by altering their health-related habits. Studies have shown that persistent effort to increase physical activity and decrease overeating is effective in preventing the onset of diabetes (Dunkley et al., 2014; Lindström et al., 2006). Therefore, many organizations have developed guidelines for diabetes management based on many previous studies (Rydén et al., 2013).

In addition to the primary factors that promote onset of diabetes, active and passive smoking are also associated with increased risk of insulin resistance and type 2 diabetes (Houston et al., 2006; Willi et al., 2007; Kowall et al., 2010; Thiering et al., 2011). According to the World Health Organization, it is estimated that 36% of male and 7% of female adults worldwide smoke tobacco (World Health Organization, 2012). Despite the drastic decrease of smoking rate from 35.1% (66.3% in male, 6.5% in female) in 1998, the rate in age 19 or above in Korea was still high as 24.2% (43.1% in male, 5.7% in female) in 2014 (Statistics Korea, 2016b). Smoking is significantly related to various diseases (Jha et al., 2013), and also presents a secondary problem by exposing others to passive smoke, otherwise known as secondhand smoke.

A national policy of promoting smoke-free environment may have contributed in the decreased smoking rate in Korea. In 1995, smoking in public areas was banned (Korea Ministry of Health and Welfare, 2016) and similar to laws were passed in other developed countries. However, many facilities that are frequently visited such as restaurants and recreational facilities were exempt at that time. In 2013, the range of public places in which smoking is banned was enlarged, and currently most indoor facilities prohibit smoking (Korea Ministry of Health and

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Welfare, 2016). The effects of this law have been studied, and recent results have shown a decreased smoking ratio in indoor public places and a resulting improvement in air quality (Lee et al., 2015; Oh et al., 2013).

It is possible to evaluate the effect of the smoking ban in public places because the government has the authority to control smoking in public places. However, smoking at home or in the workplace is not managed by the government; therefore, the effects of smoking in these locations on disease progression have not been examined. Moreover, studies on the association of smoking with diabetes have mostly focused on the onset of diabetes rather than diabetes management or glycemic control (Ko et al., 2011; Pan et al., 2015).

The purpose of this study was to determine whether secondhand smoke affects the management of diabetes. This is important not only because of the prevalence and harmful complications of diabetes, but also because an association may suggest that secondhand smoke could affect other related chronic diseases. Different types of diabetes may require different treatment, but environmental or lifestyle factors should be considered significantly in managing any types of diabetes. Therefore, we focused on environmental factors and overall management of diabetes regardless of its type, and did not distinguish the study population by types of diabetes. We investigated the exposure to secondhand smoke in the home and in the workplace, to determine which location affects glycemic control more strongly. The results will provide policymakers and healthcare providers additional factors to consider when attempting to reduce the effects of exposure to secondhand smoke.

2. Methods

2.1. Data source and study population

This study used data from the 2007–2014 Korea National Health and Nutrition Examination Survey (KNHANES), which was conducted by Korea Center for Disease Control and Prevention (KCDC) to assess the current status and trends of health and nutrition among Koreans. The survey provides a source to evaluate health policies and programs statistically, as it includes health examination results, health-related interviews, and nutrition surveys. KNHANES adopted a multi-stage clustered probability design for selecting study population in order to reflect all the noninstitutionalized population in Korea. All participants in the survey provided written informed consent. KNHANES was approved by the Institutional Review Board of KCDC (2007-02CON-04-P, 2008-04EXP-01-C, 2009-01CON-03-2C, 2010-02CON-21-C, 2011-02CON-06-C, 2012-01EXP-01-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C), and this study was conducted according to the Declaration of Helsinki in 2013.

The total sample size of the survey was 65,973 participants. Among them, only those older than 19 who were diagnosed with diabetes or revealed to have diabetes by examination of the data were included. We defined in this study those whose fasting blood glucose level was 126 mg/dL or higher as newly found diabetes patients (American Diabetes Association, 2016a). Those with missing data were excluded, resulting in a final sample that included 1168 male and 1248 female participants.

2.2. Dependent variable

According to the American Diabetes Association (ADA), the optimal HbA1c level for non-pregnant adults is <7% (53 mmol/mol) (American Diabetes Association, 2016b). However, for healthy people age 65 or older, ADA suggests a reasonable HbA1c goal to be <7.5% (58 mmol/mol), due to clinical differences that occur during aging (American Diabetes Association, 2016c). Older adults with diabetes may have suffered from the disease for many years, and some may have complications or comorbidity. Therefore, the suggested reasonable HbA1c goal differs depending on body condition in older adults, and an HbA1c <8% (64 mmol/mol) or <8.5% (69 mmol/mol) may be acceptable as

well (American Diabetes Association, 2016c). Accordingly, glycemic control should be evaluated considering those factors, but many studies have used one unified criterion for all participants, usually HbA1c <7% (53 mmol/mol) (Davila et al., 2011). In this study, glycemic control was defined as optimal if: (1) HbA1c was <7% (53 mmol/mol) in younger adults (under age 65) or (2) HbA1c was <7.5% (58 mmol/mol) in older adults (age 65 or older). Glycemic control was considered poor if HbA1c was above these optimal values. Health condition was not considered in this study, as we could not evaluate that using KNHANES data.

2.3. Primary independent variable

Exposure to secondhand smoke was confirmed based on the questions, “During the past 7 days, have you breathed smoke at your workplace from someone other than you who was smoking tobacco?” and “During the past 7 days, have you breathed smoke at your home from someone other than you who was smoking tobacco?” The responses to these questions were only “yes” or “no,” and did not include of the amount of time spent breathing the tobacco smoke. It was assumed that people who answered yes to those questions were regularly exposed to secondhand smoke in their environment, because the smoking habits of others at their home or workplace were likely to have been consistent over time, and these are the locations where most people stay for the greatest portions of their day.

2.4. Covariates

The covariates for this study were age group, residence area, marital status, education level, income, occupation, health insurance type, diagnosis date of diabetes, medication therapy for diabetes, tobacco use, alcohol use, average walking time per week, days of strength training per week, body mass index (BMI), hypertension, hypercholesterolemia, hypertriglyceridemia, anemia, diagnosis of cancer, diagnosis of liver cirrhosis, and diagnosis of renal failure. These covariates were suggested as factors associated with glycemic control in previous studies (Garcia-Compean et al., 2009; Ferrannini and Cushman, 2012; Scottish Study Group for the Care of the Young Diabetic, 2001; Khattab et al., 2010).

2.5. Statistical analysis

All statistical analyses were conducted using SAS 9.4 software. The chi-squared test was used for descriptive statistics for all variables, and a p-value <0.05 was considered statistically significant. The Cochran-Armitage trend test was applied to test trends for ordinal variables. Logistic regression analysis was used to determine the correlation between secondhand smoke and HbA1c level by calculating odds ratios (ORs) with 95% confidence intervals (CIs). A sub-group analysis was performed to evaluate the association between secondhand smoke and glycemic control after separation of participants based on income status and various healthy/unhealthy behaviors.

3. Results

3.1. Sociodemographic and health-related characteristics and glycemic control

1168 male and 1248 female participants were included in the analysis (Tables 1 & 2). Among the 715 males (61.2%) not exposed to secondhand smoke, 384 (53.7%) exhibited good glycemic control and 331 (46.3%) exhibited poor glycemic control. Males exposed to secondhand smoke included 27 (2.3%) exposed at home, 391 (33.5%) at the workplace, and 35 (3.0%) at both locations. However, the proportions in the optimal and poor glycemic control groups were not statistically different by location of exposure.

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